ENGINEERING AND
BOILER HOUSE REVIEW

ESTABLISHED 1899

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VOL. 74 NO. 10 • THE PIONEER STEAM JOURNAL • OCTOBER, 1959

Electroflo
Meters & Controls

THE MOST EFFICIENT MEANS OF FLUID FLOW MEASUREMENT

1 One operating principle — one general construction mode — for all fluids and gases under all conditions of measurement. Minimum service requirement.

2 Standardised, independent and interchangeable reading instruments — located at any distance from actual measuring point: separated grouped or duplicated to meet any operating or supervisory requirement.

3 Linear scales. Square root extraction effected by parabolic contour of resistance element.

4 Full 4" mercury rise.

5 Unrestricted mercury column gives maximum sensitivity to flow rate changes. Accurate to within ±0.5%. Differential pressure change modifies circuit resistance. Conductance proportional to flow rate: easily checked in situ by substitution of standard resistance.

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7 NO CASTINGS. — Interchangeable tubular manometer with drop-forged ends. Readily available for any specified line pressure. No glands: integral equalising valve: over-range protection and dirt traps

8 High-speed, frictionless integration. Integration is totalising conductance meter measuring amperes x time/volts.

9 Wide choice of interpretive instruments — see illustrations.

10 Equipped for data reduction: control circuits and available for long distance transmission. Also accepts 3-15 p.s.i. pneumatic signal. Further particulars on application

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Model No. 259 6"x 6" high-speed integrator

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Model No. 355 12" diam. rate-of-flow indicator

Model No. 350 multi-point, 12" continuous roll chart recorder

Model No. 224 12" diam. recorder: 10½" diameter linear chart

Model No. 223 10" scale edgewise type rate-of flow indicator

TENS OF THOUSANDS IN OPERATION IN EVERY CLASS OF INDUSTRY THROUGHOUT THE WORLD. FOR FURTHER PARTICULARS, ASK PUBLICATIONS DEPARTMENT FOR CATALOGUE No. 65

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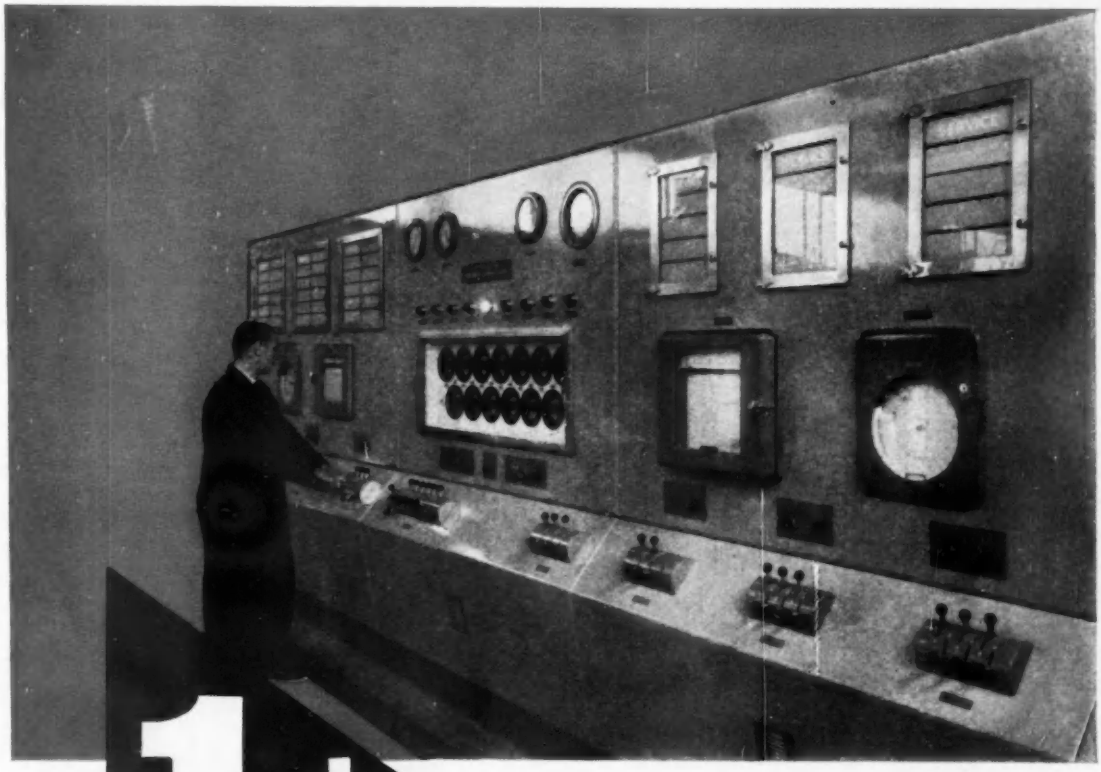

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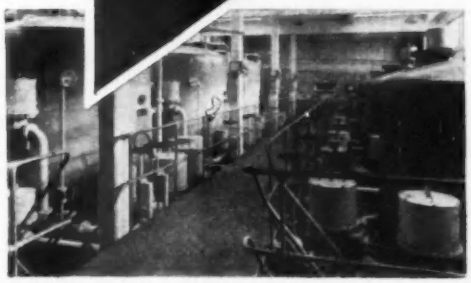

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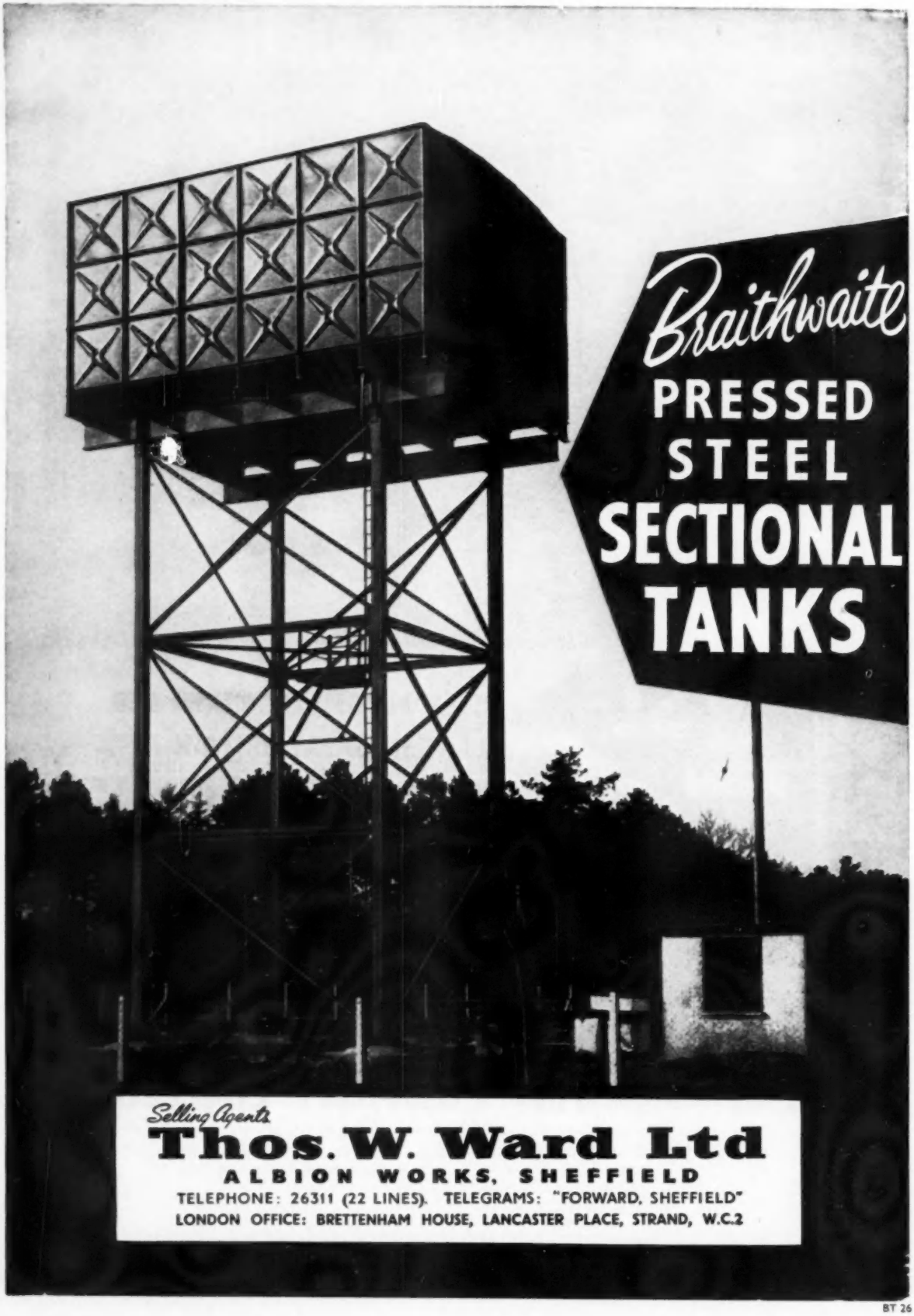

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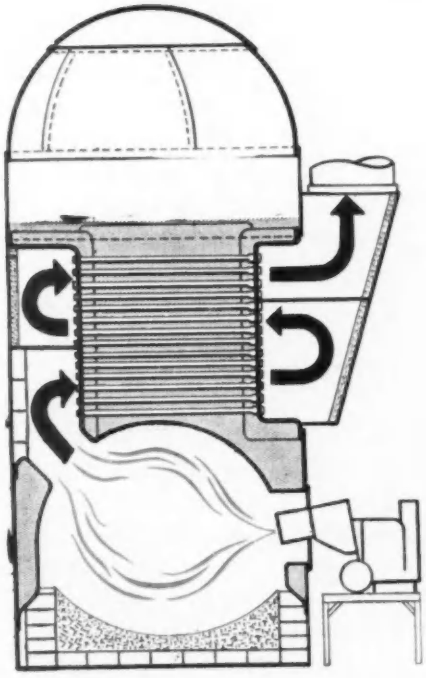
THE NEW COCHRAN

A HIGH EFFICIENCY VERTICAL BOILER with—



- ★ **All the advantages of the well known Cochran design and construction.**
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- ★ **Readily convertible to solid fuel.**
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All these advantages are achieved without sacrificing the essential design features of Cochran Vertical Boilers which have, over the years, shown supreme qualities of reliability and durability.

THESE BOILERS ARE ALREADY AVAILABLE IN RATINGS FROM 1,750 to 8,300 lbs./hr. from and at 212°F and an early extension of the range is planned. The Standard Range of Cochran Vertical Boilers will continue to be available.

Leaflet C.B. 94 describes the Series II boiler.

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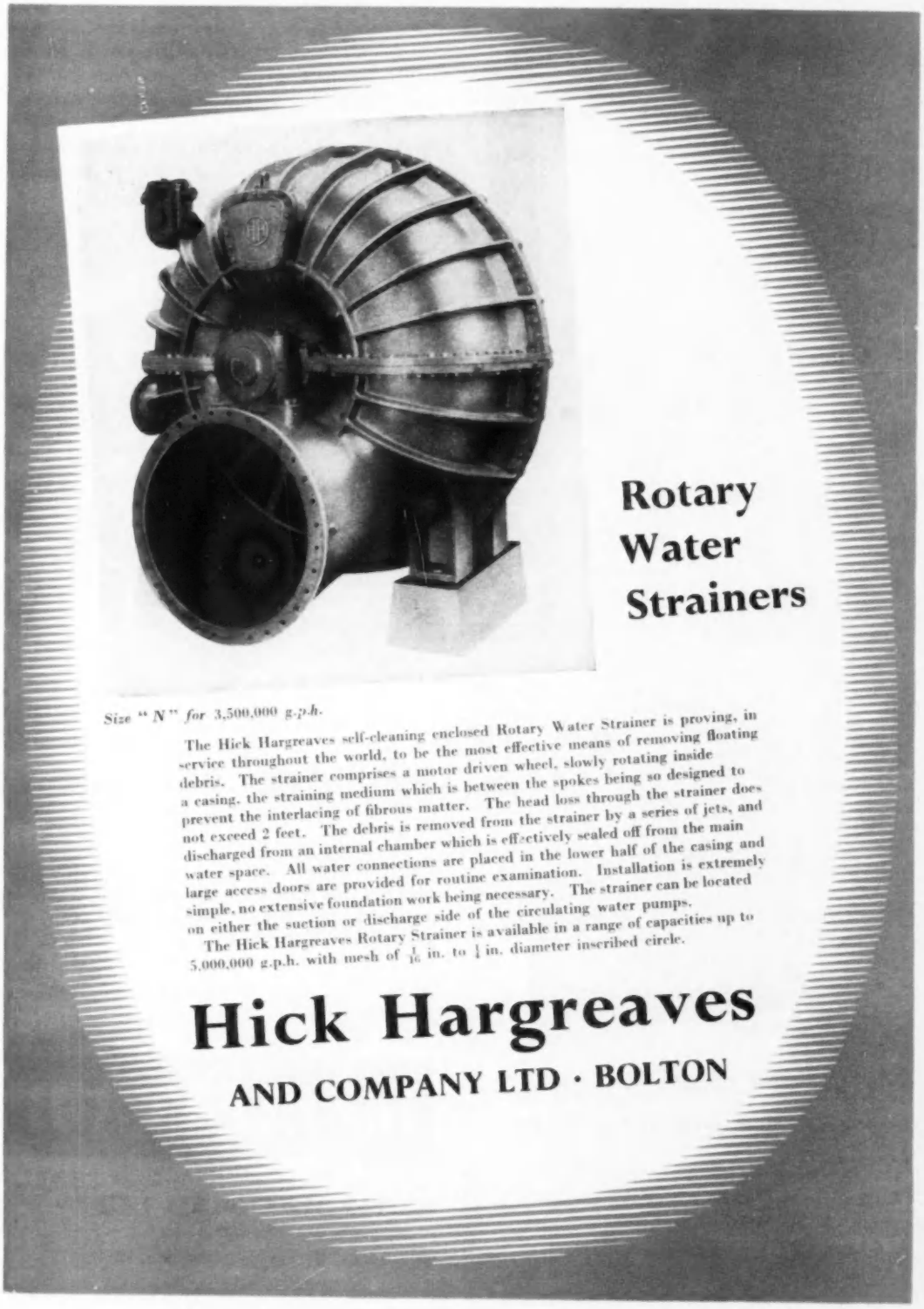


Rotary Water Strainers

Size "N" for 3,500,000 g.p.h.

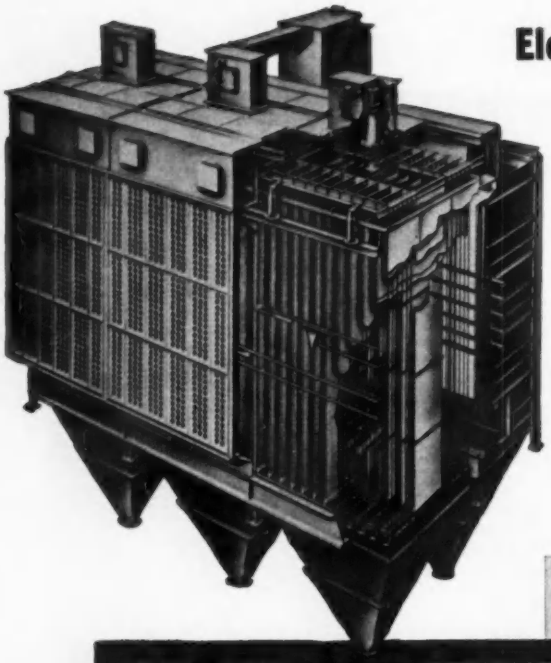
The Hick Hargreaves self-cleaning enclosed Rotary Water Strainer is proving, in service throughout the world, to be the most effective means of removing floating debris. The strainer comprises a motor driven wheel, slowly rotating inside a casing, the straining medium which is between the spokes being so designed to prevent the interlacing of fibrous matter. The head loss through the strainer does not exceed 2 feet. The debris is removed from the strainer by a series of jets, and discharged from an internal chamber which is effectively sealed off from the main water space. All water connections are placed in the lower half of the casing and large access doors are provided for routine examination. Installation is extremely simple, no extensive foundation work being necessary. The strainer can be located on either the suction or discharge side of the circulating water pumps.

The Hick Hargreaves Rotary Strainer is available in a range of capacities up to 5,000,000 g.p.h. with mesh of $\frac{1}{16}$ in. to $\frac{1}{4}$ in. diameter inscribed circle.

Hick Hargreaves

AND COMPANY LTD · BOLTON

H.139B



Electrostatic Precipitators

Made under licence from the Aerotec Corpn., U.S.A., these precipitators have an extremely high collection efficiency, low current consumption and many novel design features including screen-grid type collecting electrodes which minimise re-entrainment and consequent emission of dust. Manufactured in several combinations of width, height and length to suit available space in existing plants or most efficient usage of building volume in new constructions.

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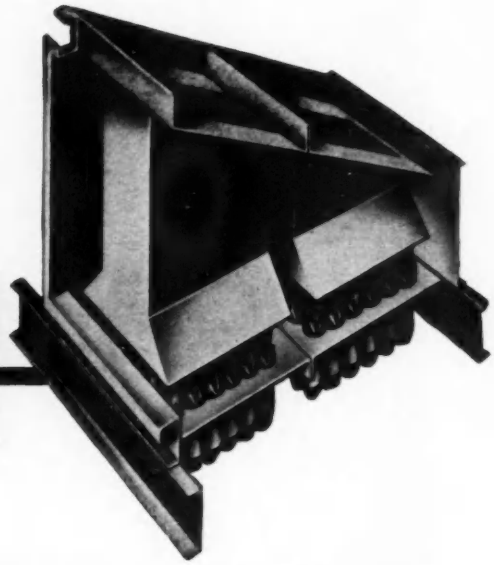

Multitubular Dust Collectors

Here is a dust collector which satisfies the ideal requirements of steam generator designers. It has a high collection efficiency at moderate resistance; maximum freedom from dust erosion; accessibility for maintenance and service; simple, low cost erection; flexibility of arrangement to meet space availability conditions. These collectors can be used in series with electrostatic precipitators and can be designed to match the precipitator inlet.

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The product of over 75 years of experience, 'Tornado' induced and forced draught fans can handle any boiler draught requirements efficiently and reliably. The type A.R. aerofoil section backward bladed centrifugal fan, with peak efficiency of 90%, is only one of the many types (another is the combined induced draught and grit arrester) produced to deal with all classes of boilers from central heating to those in the largest power stations.

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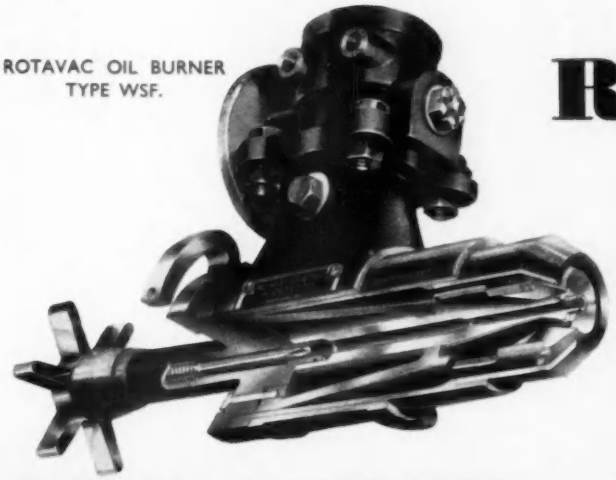

ROTAVAC
–makes boilers give their best

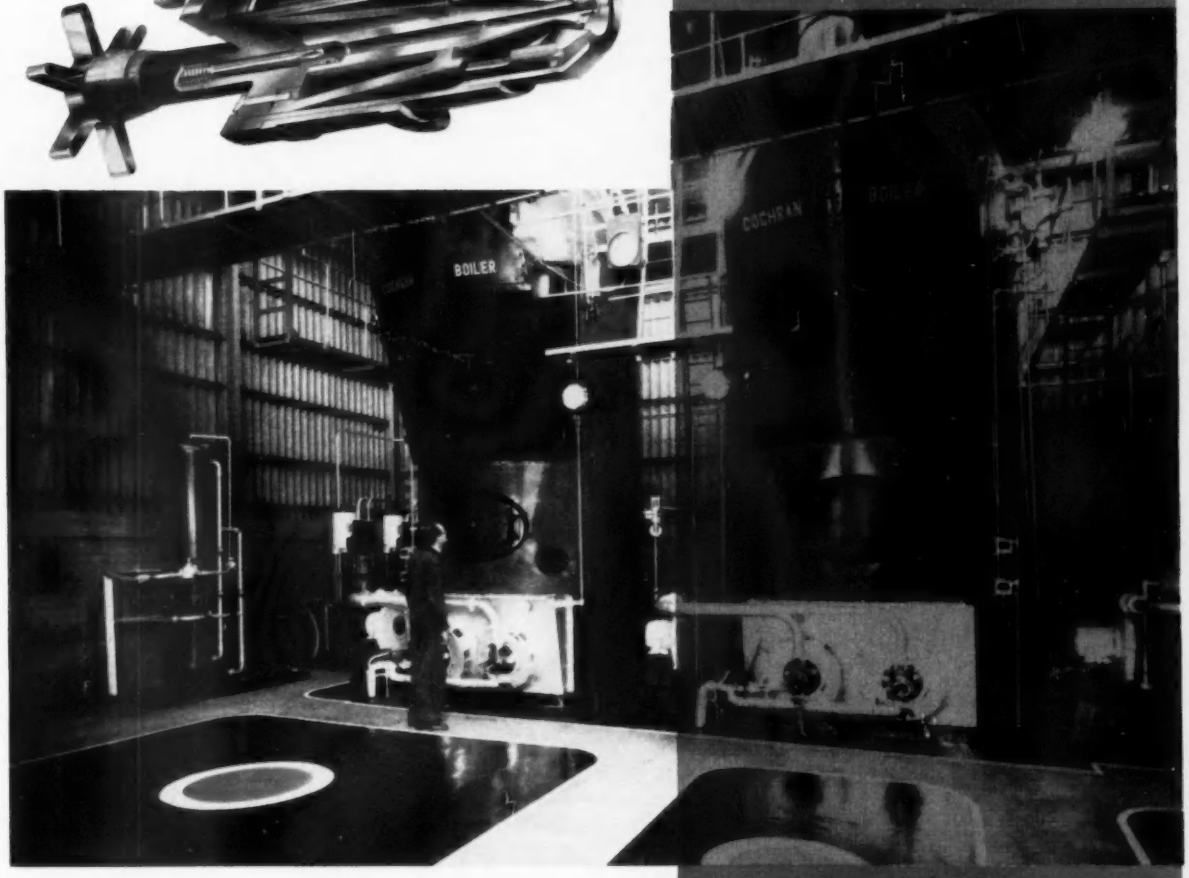

Photo by courtesy of Messrs. Cochran Boilers Ltd., and Messrs. T. and T. Vicars Ltd. Newton le Willows.

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UNSURPASSED STEAM OUTPUT per pound of fuel, year in year out, without adjustment.

ONLY ONE MOVING PART—the Fan—and that far from the flame means nothing to repair and little to maintain.

PERFECT COMBUSTION OF ANY LIQUID FUEL including the heaviest, cheapest grades. Rotavac's soft, gaseous flame is kind to brickwork and prolongs fire-box life.

ANY FORM OF CONTROL including manual, semi-automatic High/Low, or fully automatic modulation with gas-electric ignition. Send for details of ROBOT ROTAVAC—complete AUTOMATION in the Boilerhouse.

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Write now for performance details and design information to:

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STEAM FOR POWER

A complete industrial power station by Simon-Carves

STEAM FOR PROCESS

At a colliery in South Wales, Simon-Carves have designed and constructed this complete industrial power station. The contract included the three tri-drum twin-circulation type boilers with superheaters and economisers, water treatment plant, de-aerators, panels and instruments, fuel and ash handling plants, chimney, cooling tower, and all building and civil engineering work. Simon-Carves were also responsible for the design and installation of the whole of the electrical equipment in the power house, and the installation of the two double pass-out and condensing turbo-alternators and switch-gear. Steam is extracted at two pressure levels from the turbines for process plant in connection with the new coke ovens at the colliery. Simon-Carves have undertaken the design and construction of a wide variety of industrial steam plants and can offer a comprehensive designing and contracting service which enables them to accept complete responsibility for contracts of this kind.

COMPLETE INDUSTRIAL POWER PLANT BY

Simon-Carves Ltd

SIMON ENGINEERING GROUP

STOCKPORT, ENGLAND

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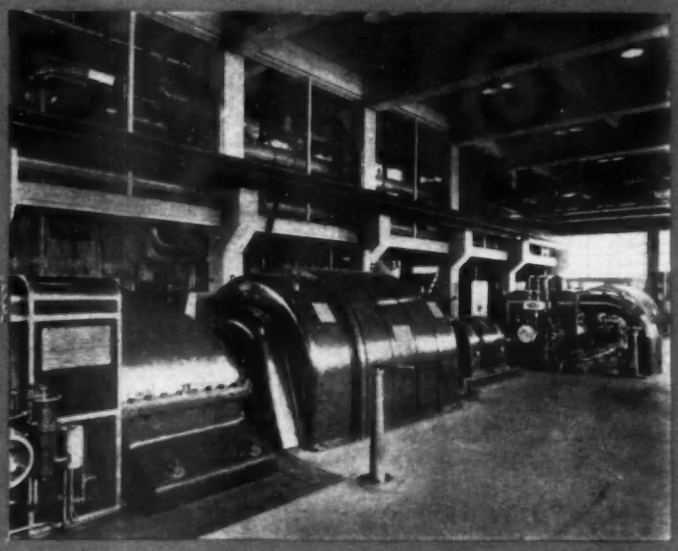
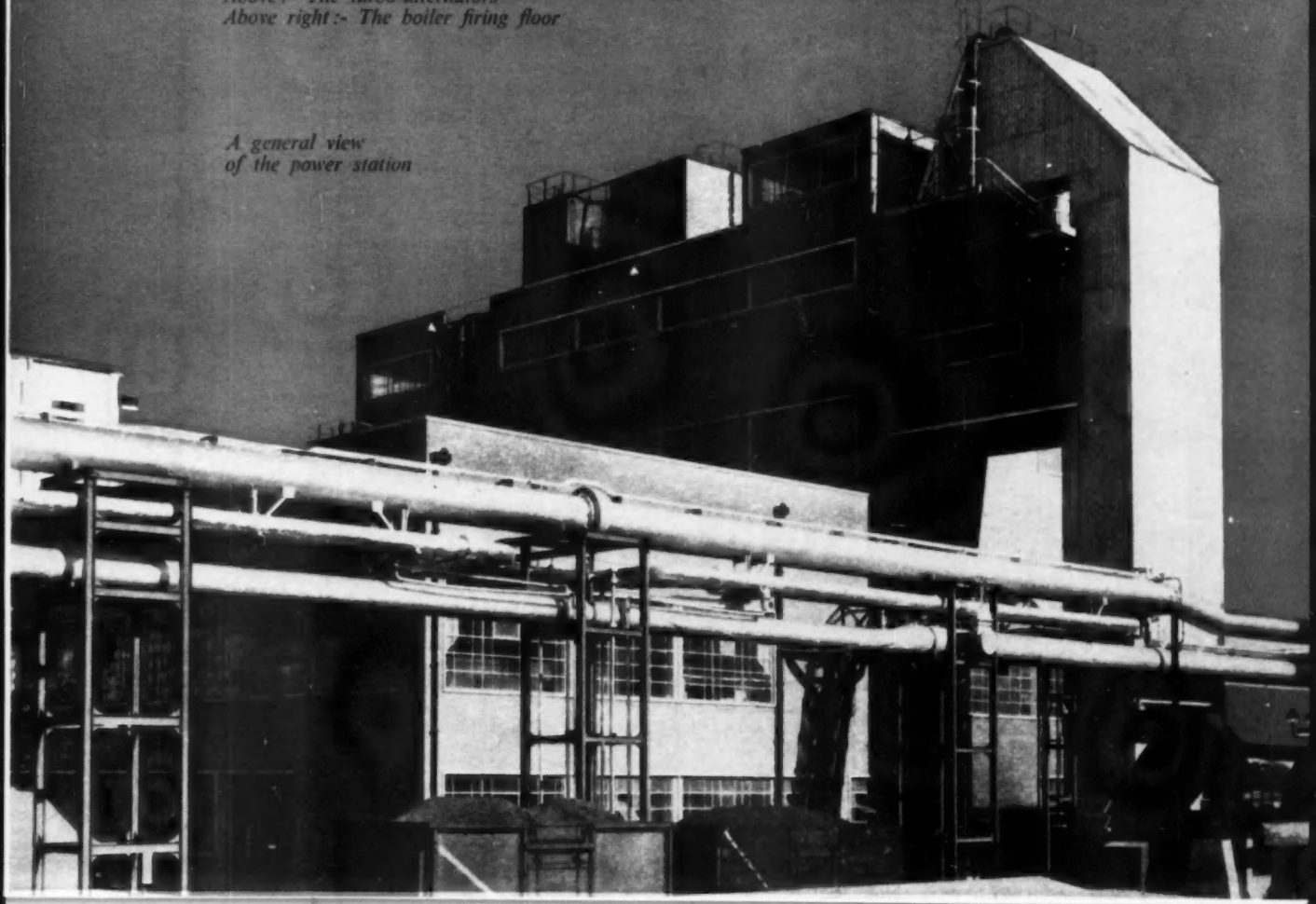
The three 50,000 lb per hour boilers, operating at 425 p.s.i. and 810°F, are equipped with mechanical stokers for sandwich firing with coal and coke with provision for alternative firing using coke oven gas. The two pass-out turbo-alternators have a continuous maximum rating of 8,000 kW with first and second pass-out pressures of 130 lb and 15 lb per sq. inch gauge respectively.



Above :- The turbo-alternators
Above right :- The boiler firing floor

A general view of the power station



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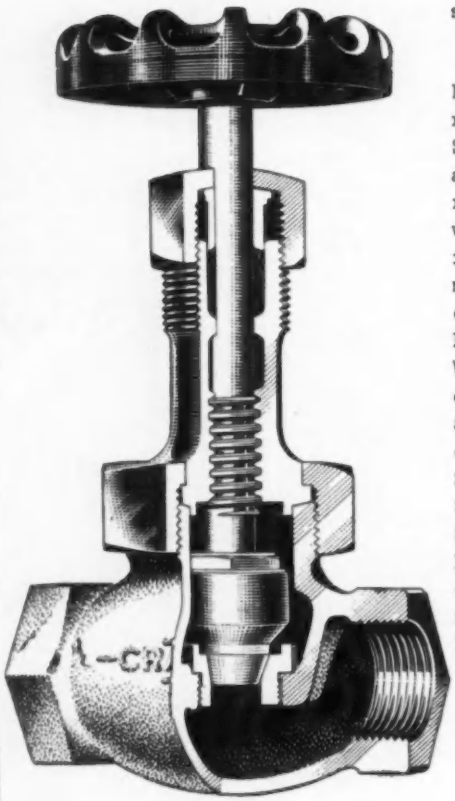

Designed for services under really rigorous conditions and made to British Standard 2060. The plug type nickel alloy disc and stainless steel seat ring make an extremely tight closure whilst allowing close regulation of flow when throttling. The two dissimilar metals offer the best resistance to corrosion and damage by foreign matter. Both disc and ring are renewable.
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Sizes 2½" and 3" have bolted bonnet.

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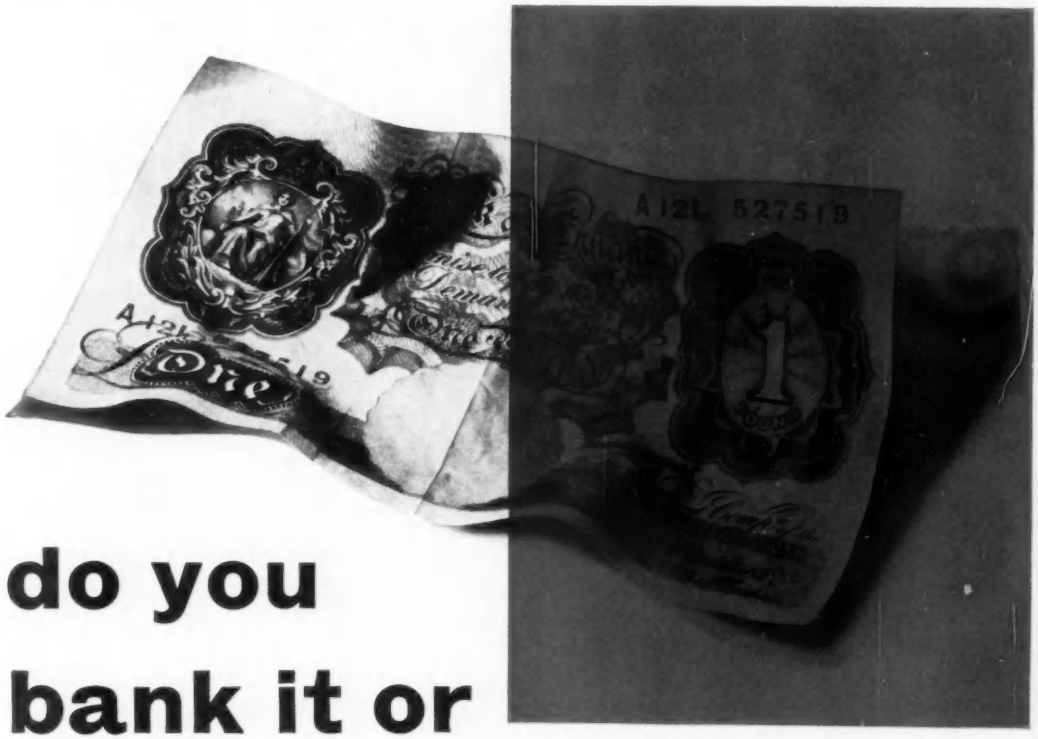

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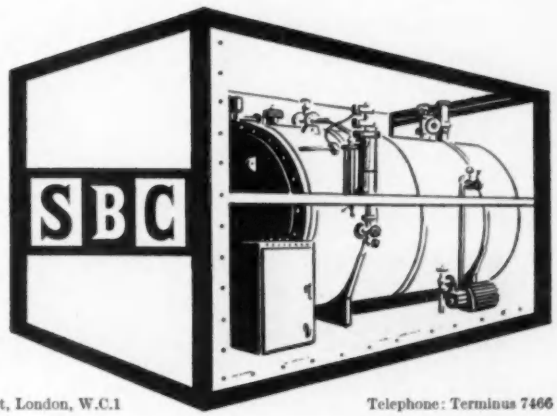

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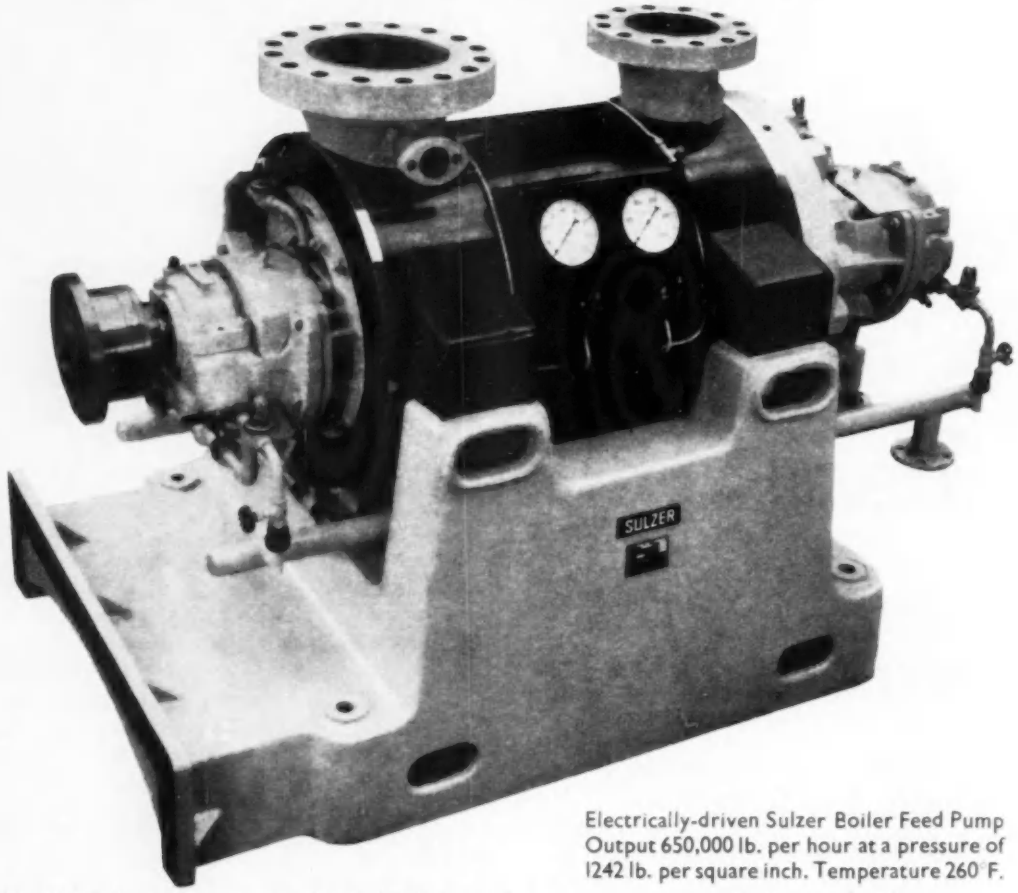

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Output 650,000 lb. per hour at a pressure of
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Complete range of Boiler Feed Pumps for nuclear and orthodox thermal plants including advanced class units.

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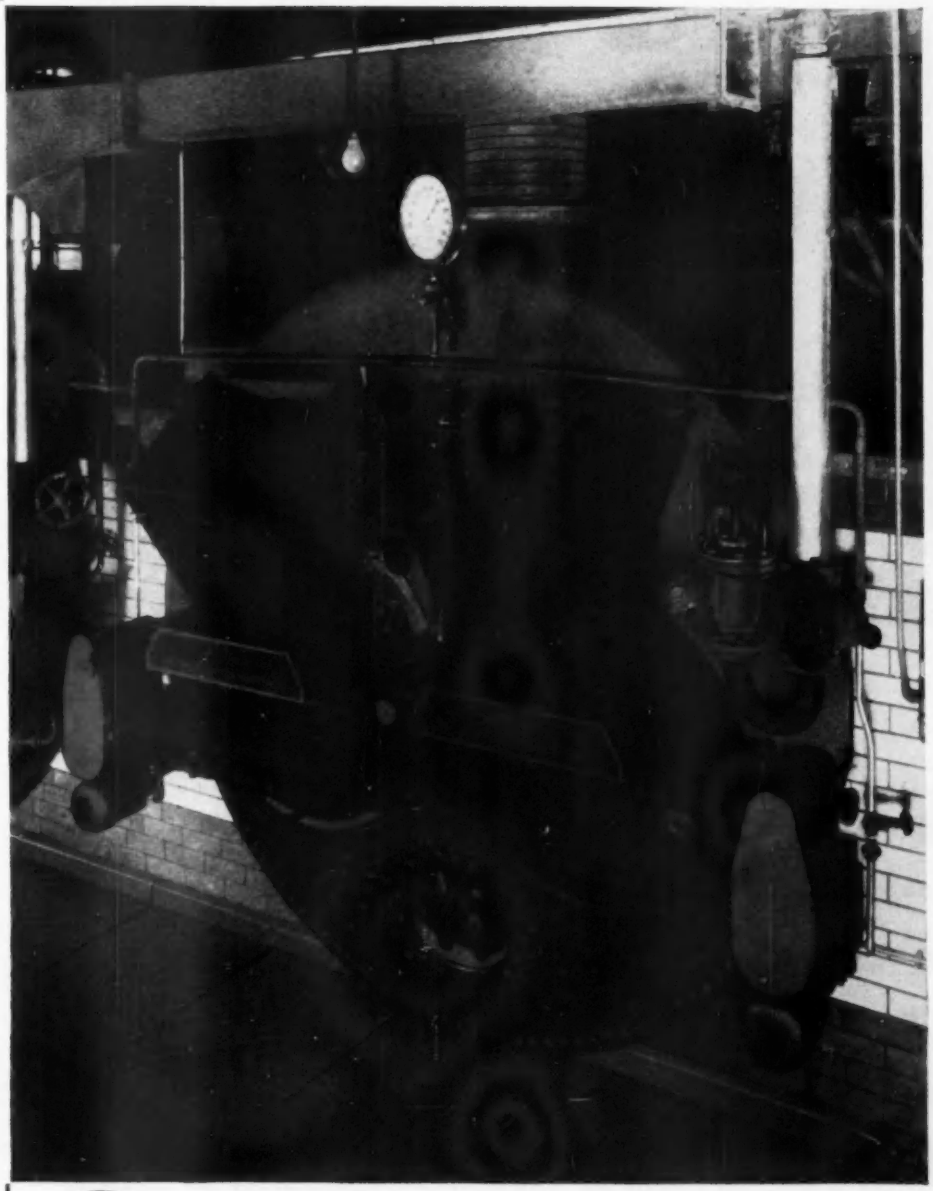

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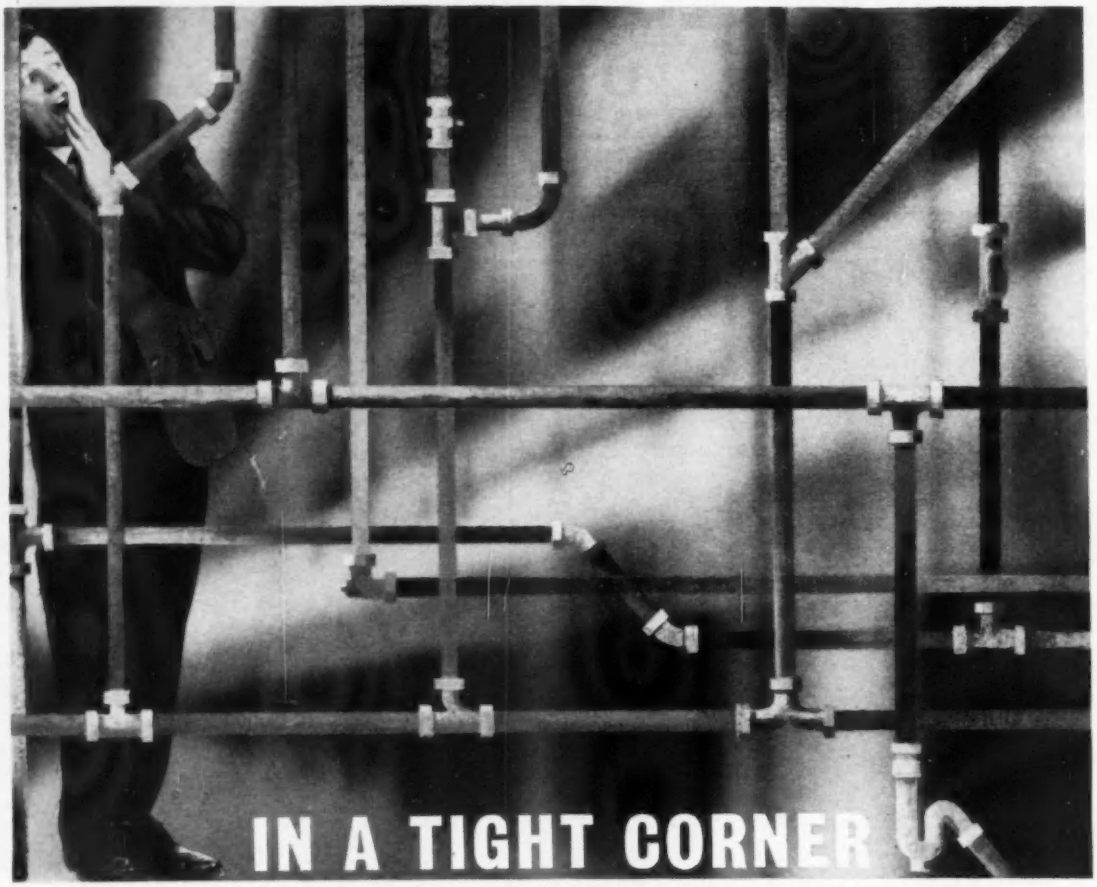

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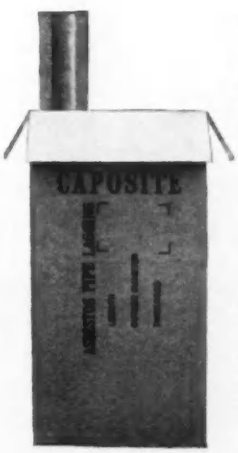

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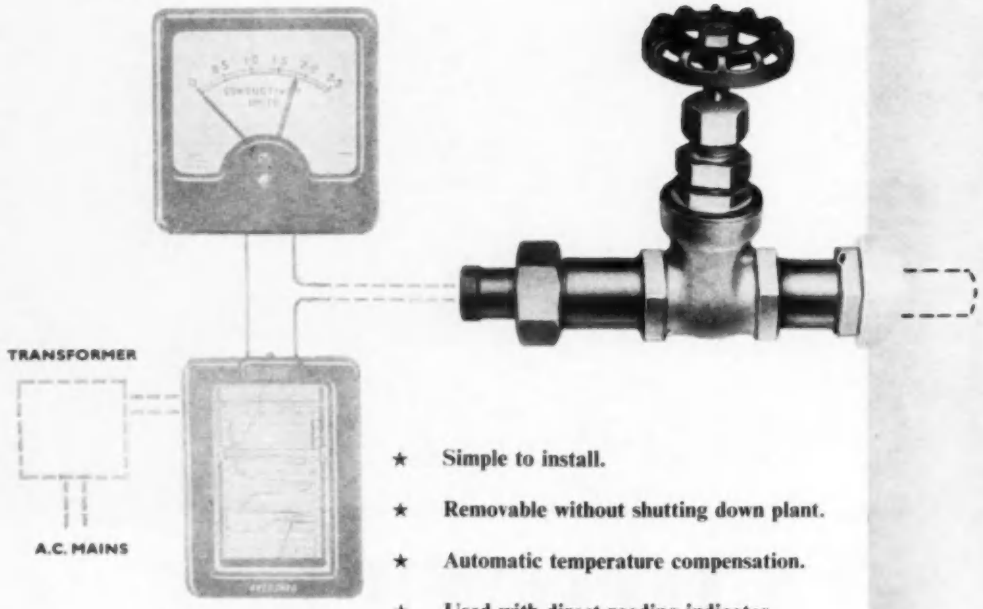

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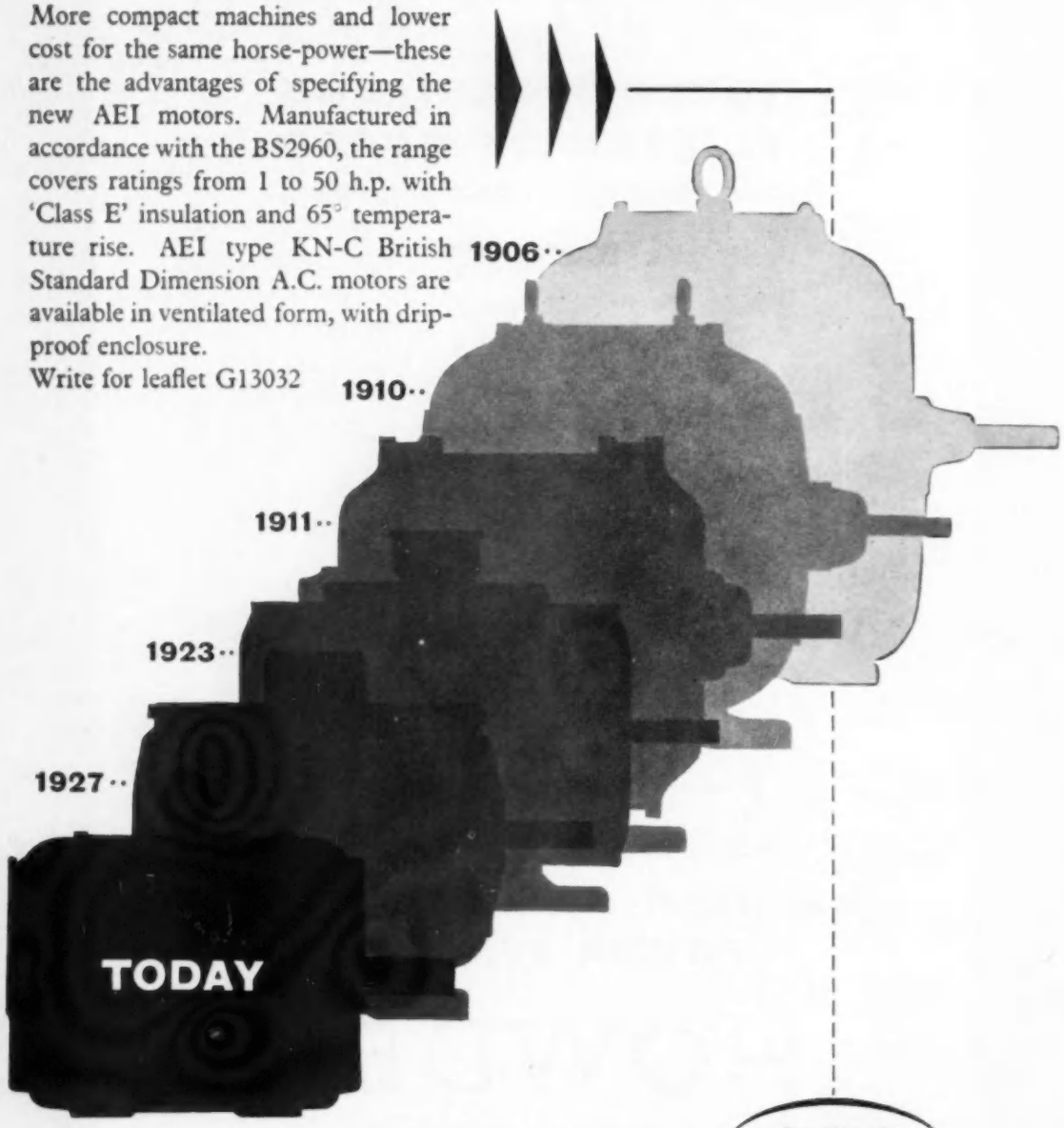

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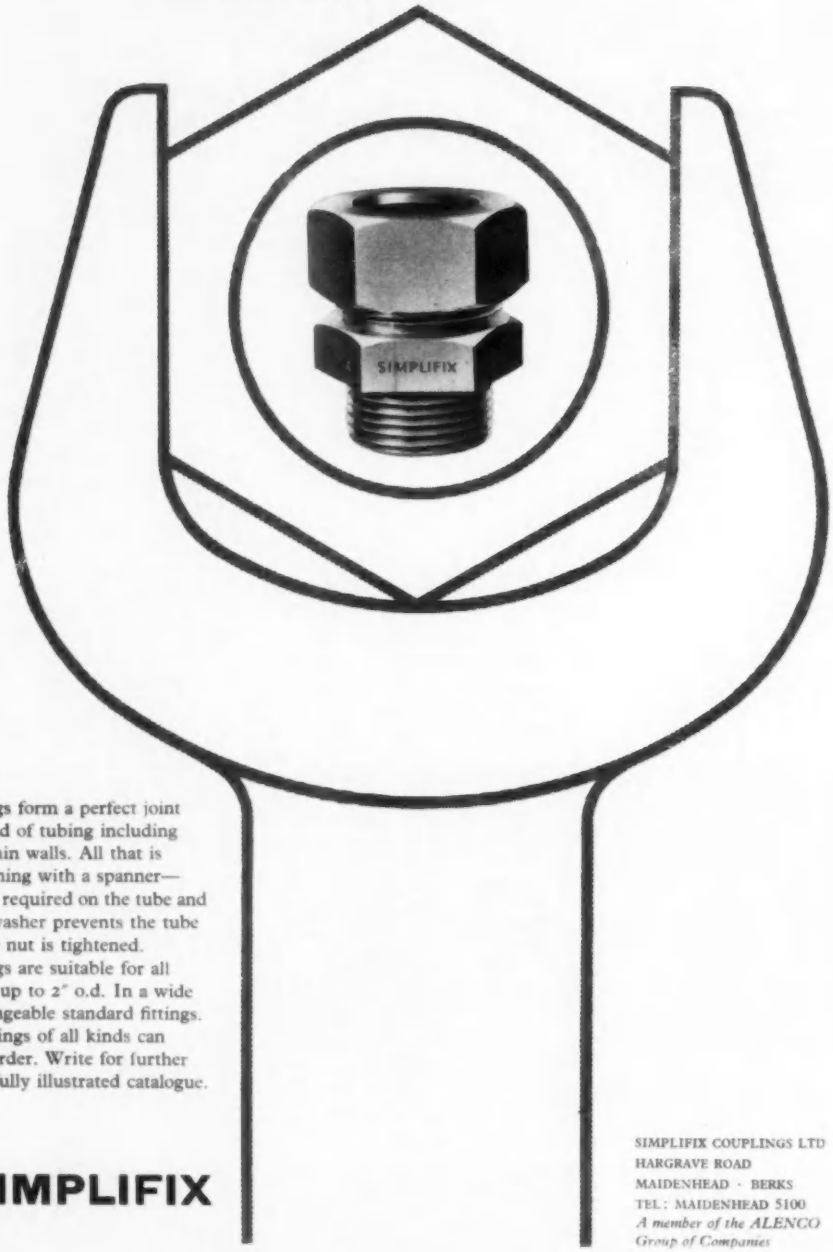

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No. 17	Dry	+1750°C	Hydraulic	1200°C	1700°C	160
No. 18	Dry	+1750°C	Hydraulic	1200°C	1800°C	160
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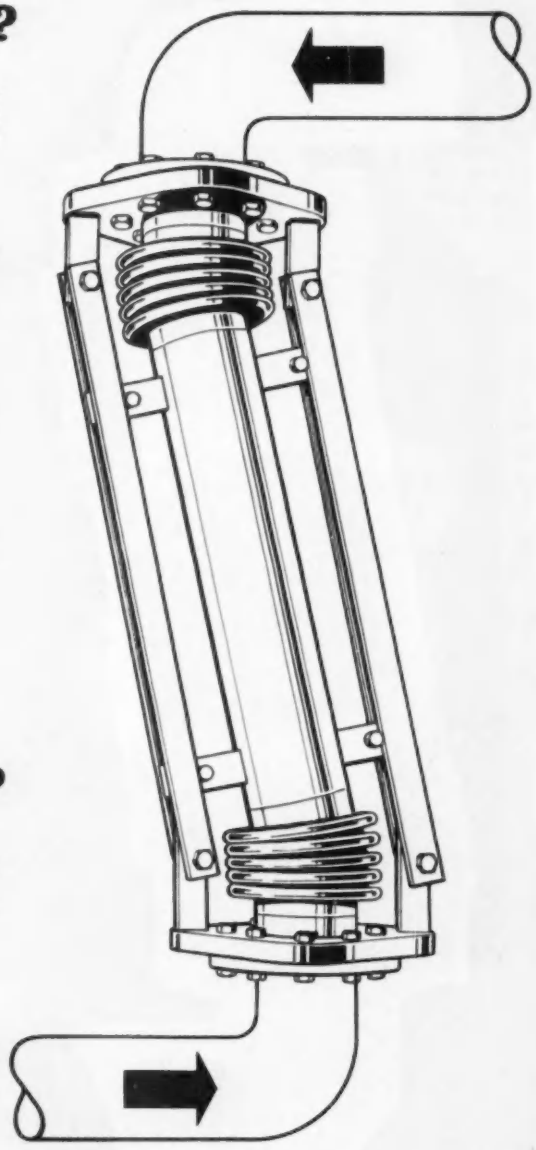

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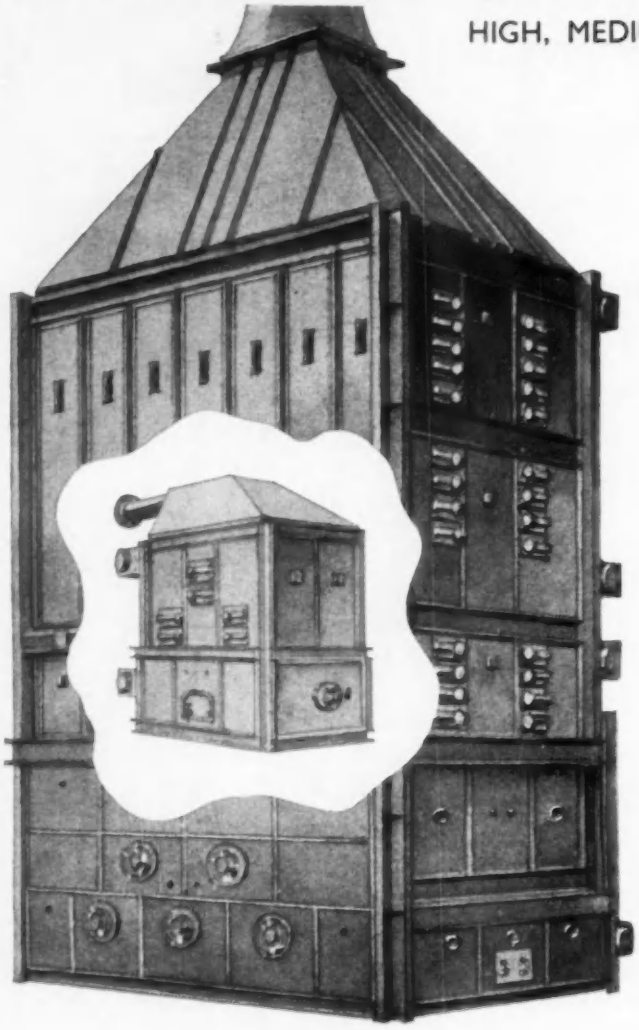

LA MONT Hot Water Boilers are installed for a wide range of capacities and conditions. Illustration shows comparative size of oil-fired boiler for capacity of 70,000,000 Btu./Hr. with 2,000,000 Btu. boiler inset to the same scale.

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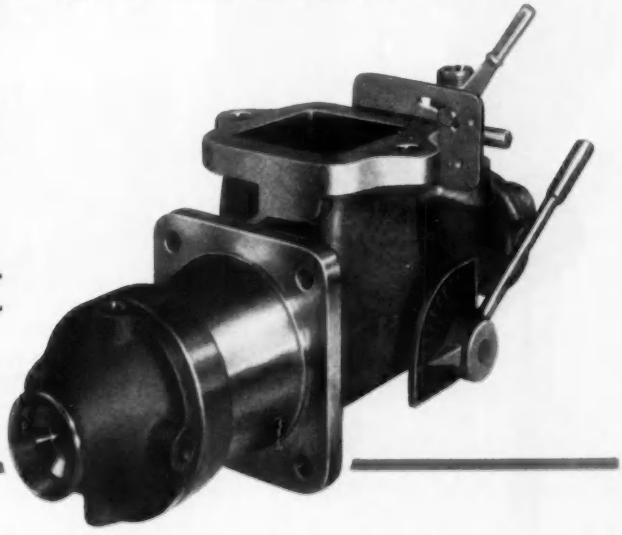

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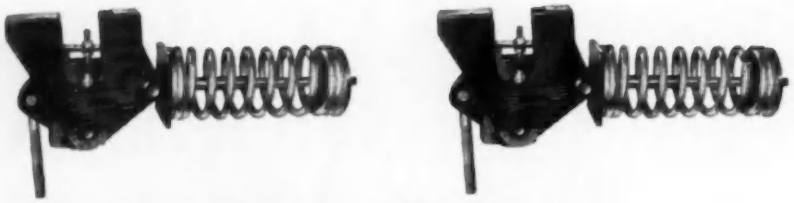

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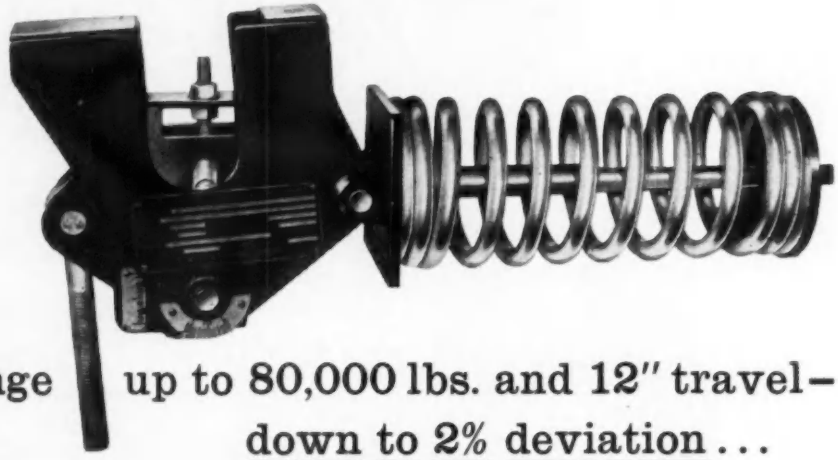

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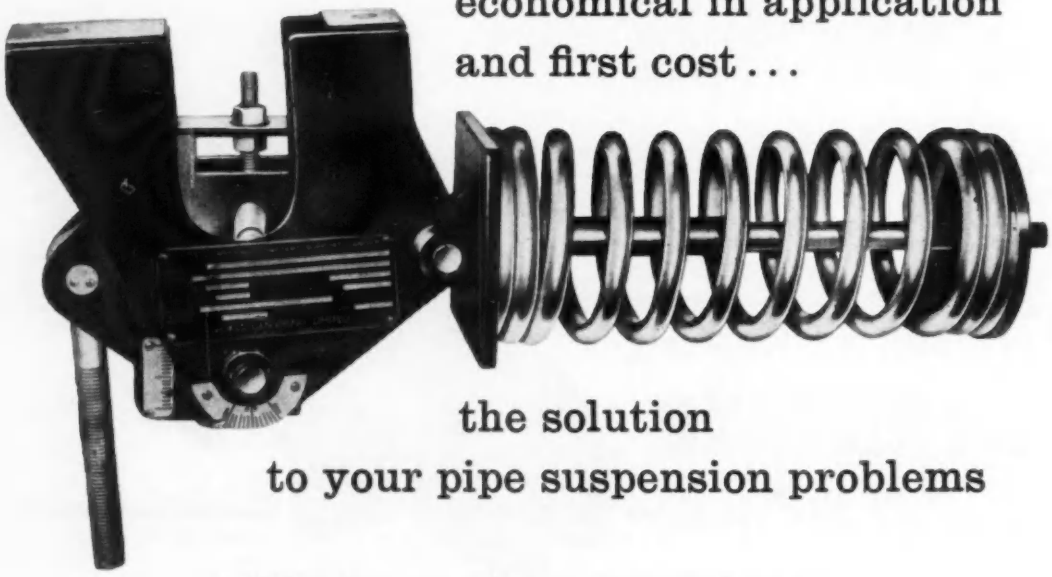

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VG/28

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Indeed, the greater the knowledge about profitable steam trapping, the more certain it is that the whole range of Spirax traps is unequalled. Which is why we're always anxious to advance both.

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.... literature describing the extended Spirax 'TD' trap range.

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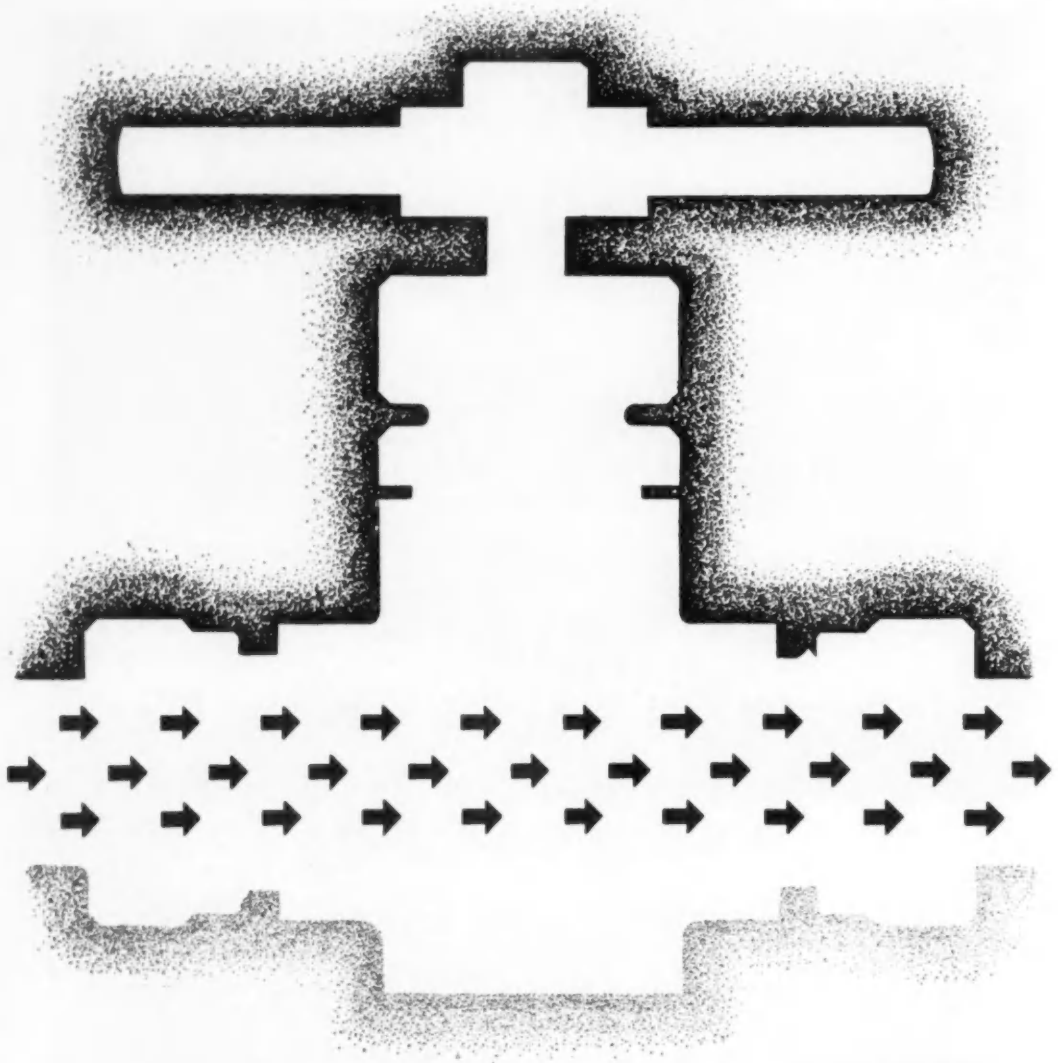

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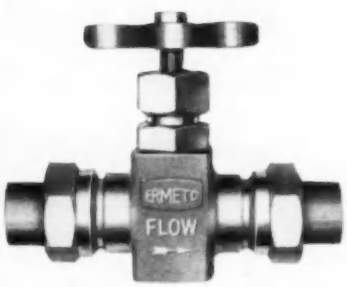

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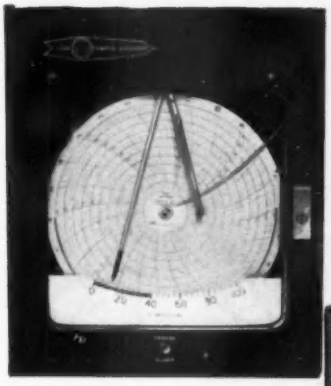
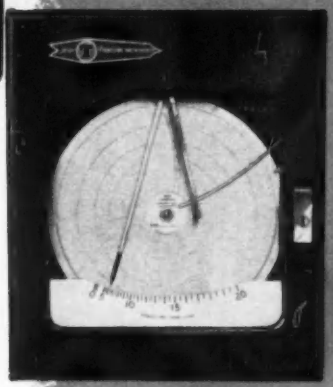


Above: Smoke Density Recorder and Indicator with warning lamps; a warning klaxon or other remote alarm system can be incorporated.



Right: Recording, Indicating and Counting Flow Meter: pointer visually indicates flow, whilst recording pen makes a permanent chart record and integrator mechanism gives a numerical count of flow.

John Thompson 'Sentinel' Series

The illustrations show two of the comprehensive series of "Sentinel" Instruments. Left above is the Smoke Density Recorder and Indicator which provides a reliable and inexpensive means of meeting the requirements of the Clean Air Act 1956, and at the same time serves as a guide to efficient combustion.

Left below is the "Sentinel" Flow Meter, available in a variety of forms for measurement and recording of flow of steam, air, gases and liquids. If required, pressure and temperature measurement can be incorporated in the same instrument.

JOHN THOMPSON INSTRUMENT CO LTD. WOLVERHAMPTON

MF.10

The illustrations show (below) a typical John Thompson-Kennicott Lime Soda water treatment plant at a works of Lever Brothers Ltd., and (right) a plant with cation exchanger employing a selective resin followed by a scrubber for CO_2 removal and a base-exchange softener, producing a water of zero hardness and low alkalinity at Charles Lennig and Co. (Great Britain) Ltd. Complete plants for treatment of water and industrial effluents, etc.

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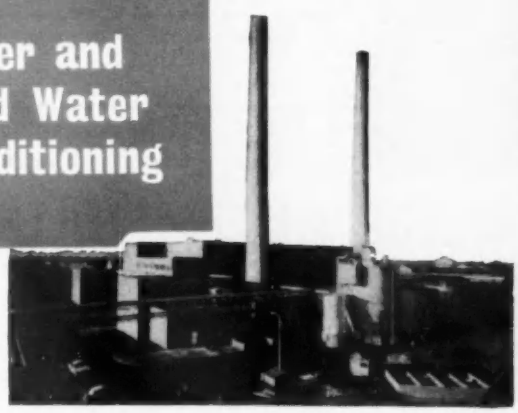

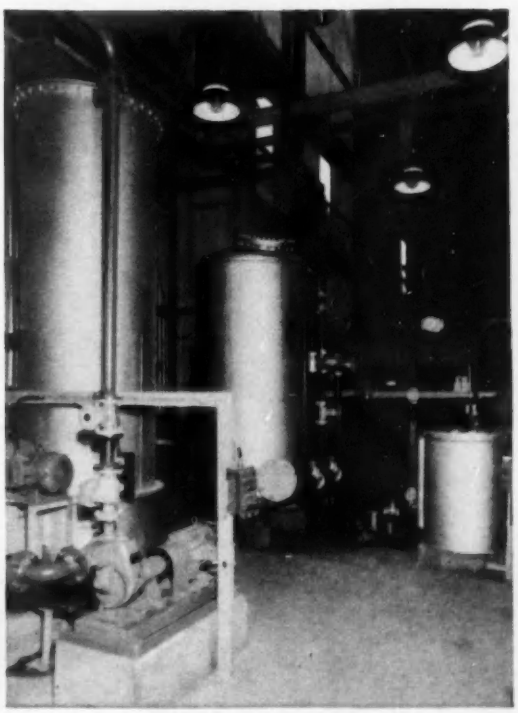

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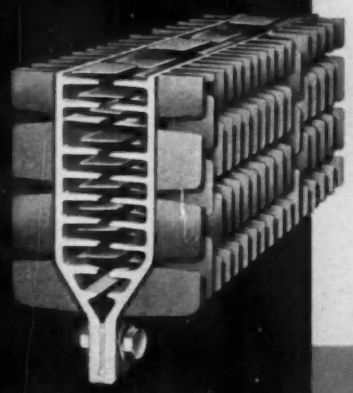

A modern plate-type extended surface air-heater, made of high grade cast iron. The corrosion-resisting properties of cast iron have long been established, and the life of the Kablitz-Green Airheater should be several times that of steel constructions.

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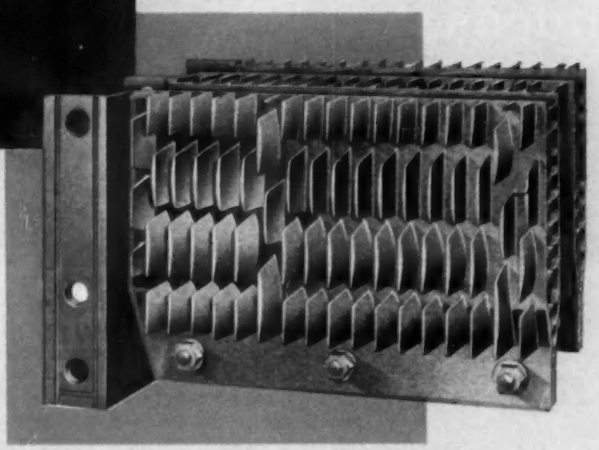
Further particulars available on request.



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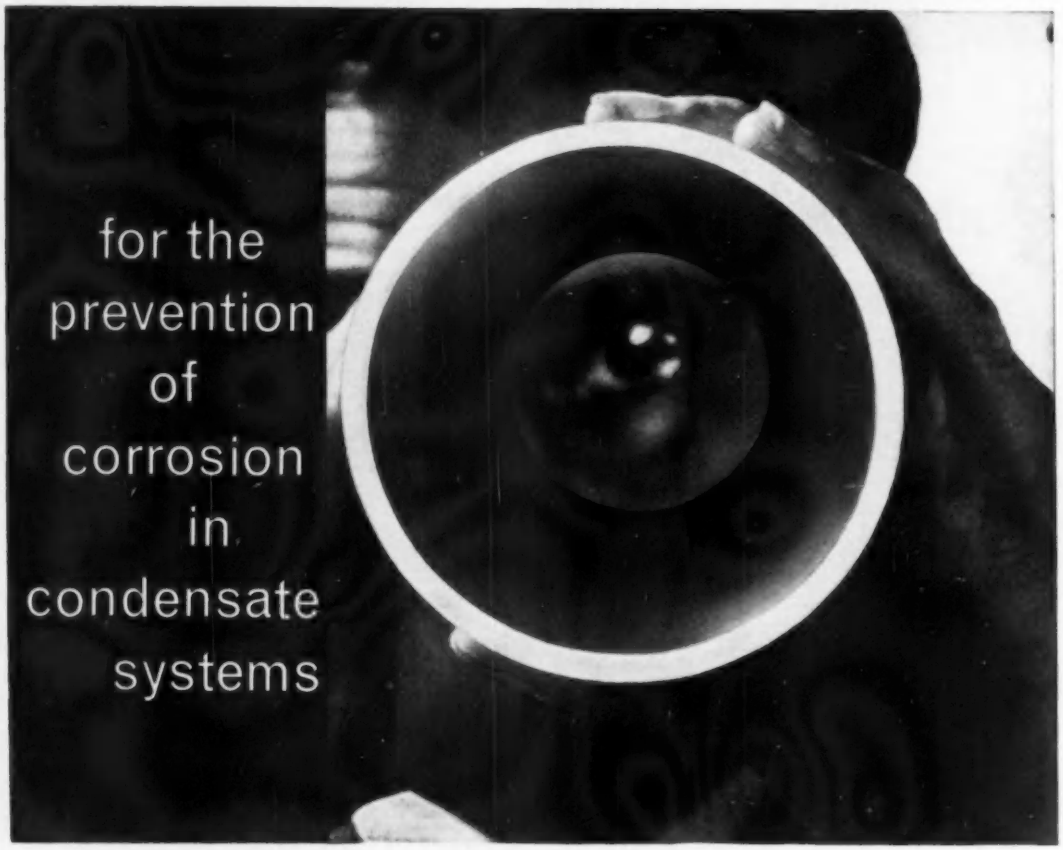

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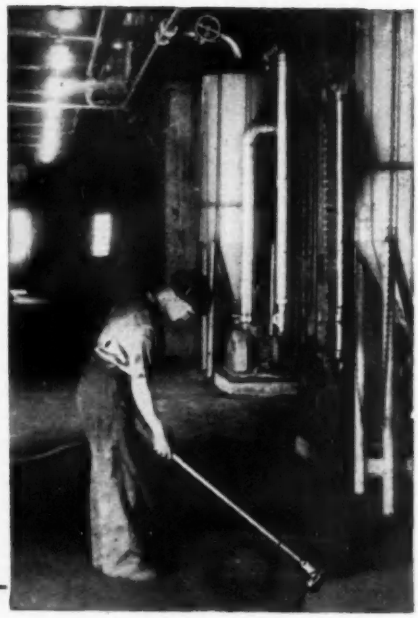

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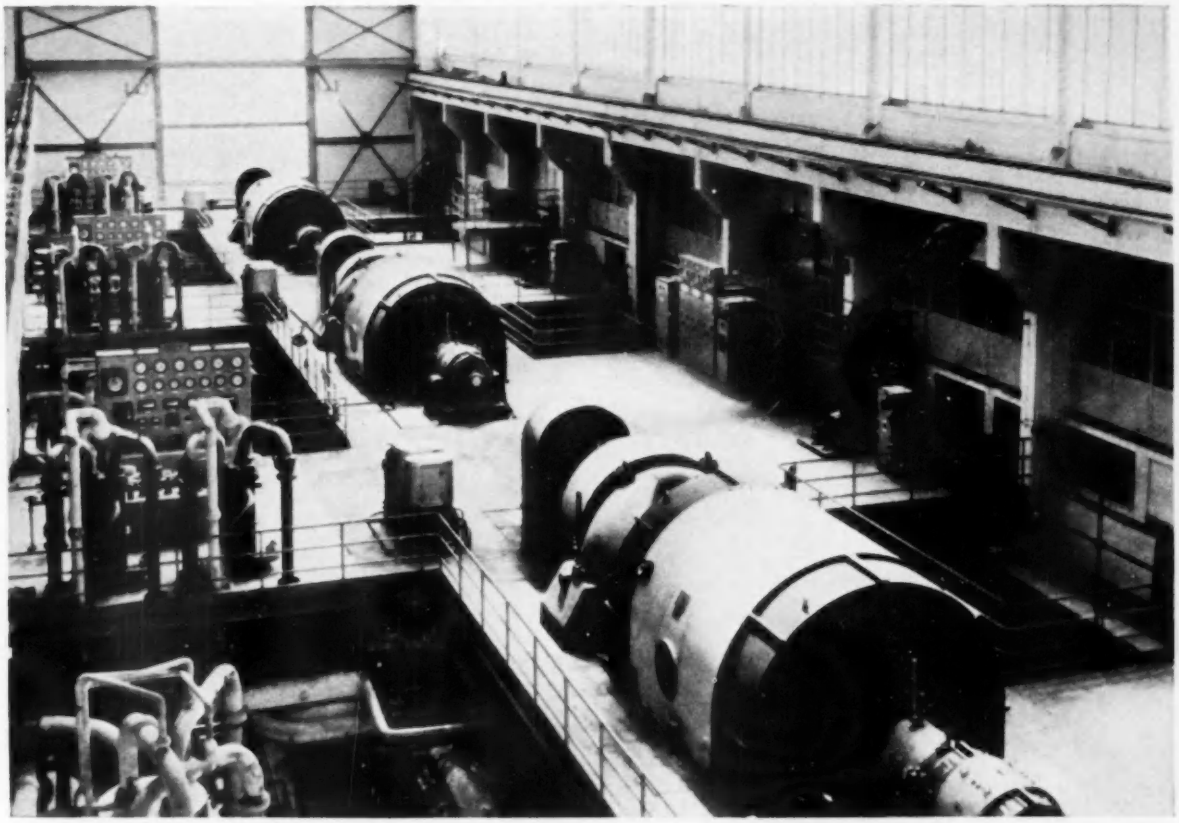

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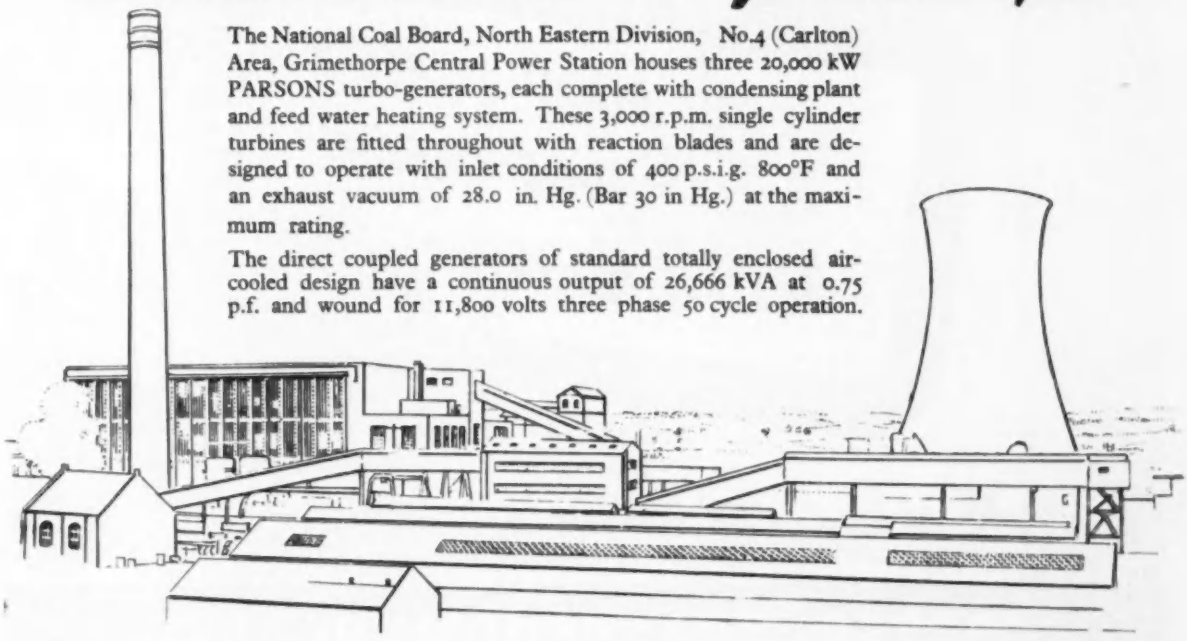

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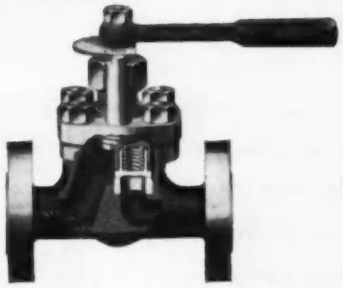

Small forged steel valves of the highest dependability. Ideal for controlling high pressure superheated steam, drain services etc. Easy access for maintenance; seat can be reground without removing valve from pipeline. Available for steam pressures up to 2,800 lb/sq. in.

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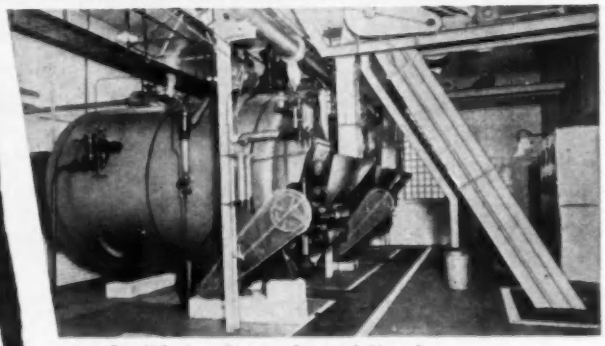
Bennis Chain Grate Stokers fitted to Economic boilers.



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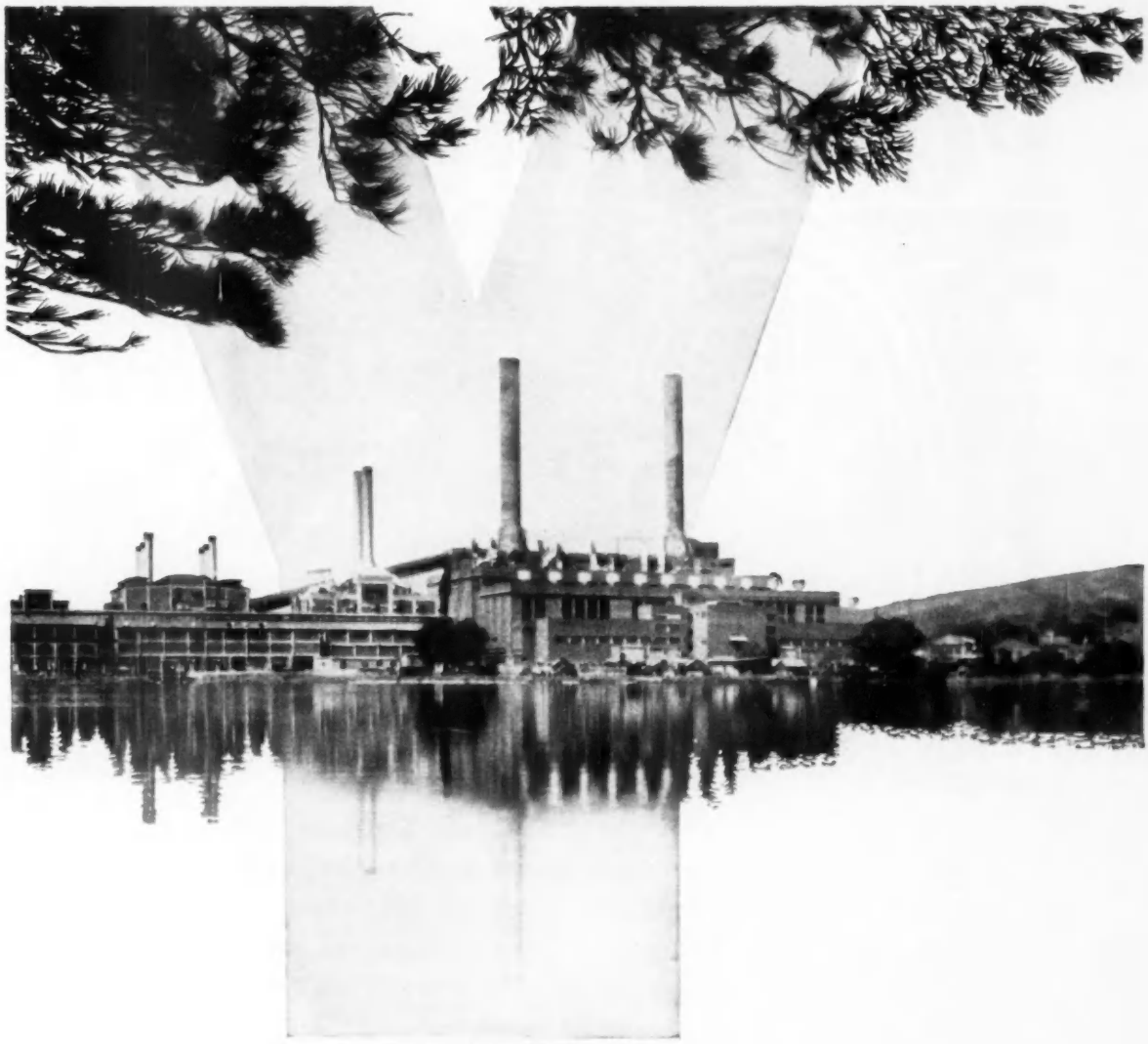

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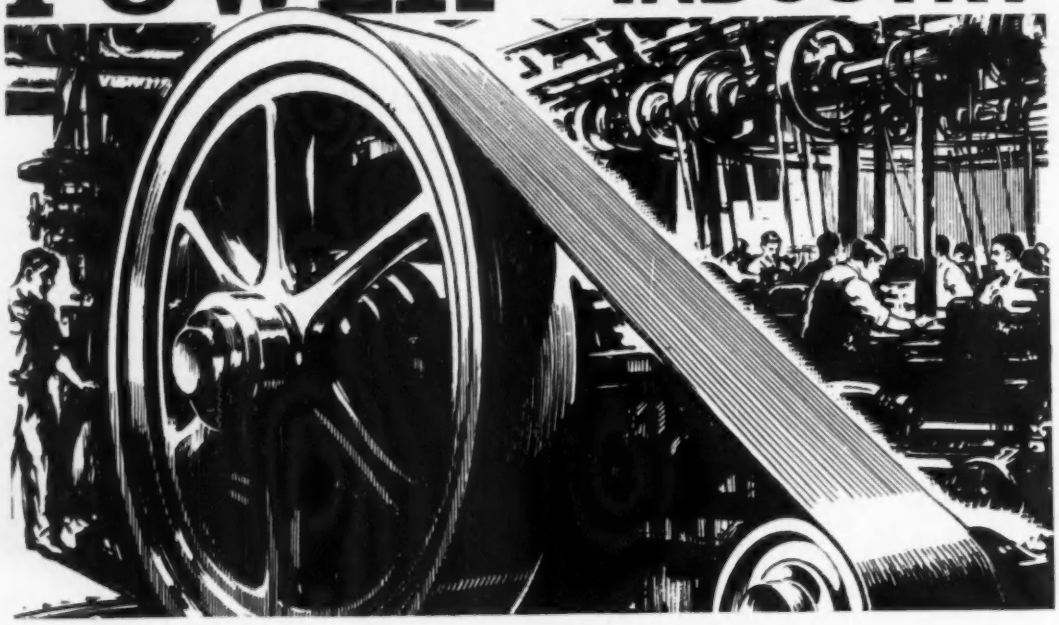

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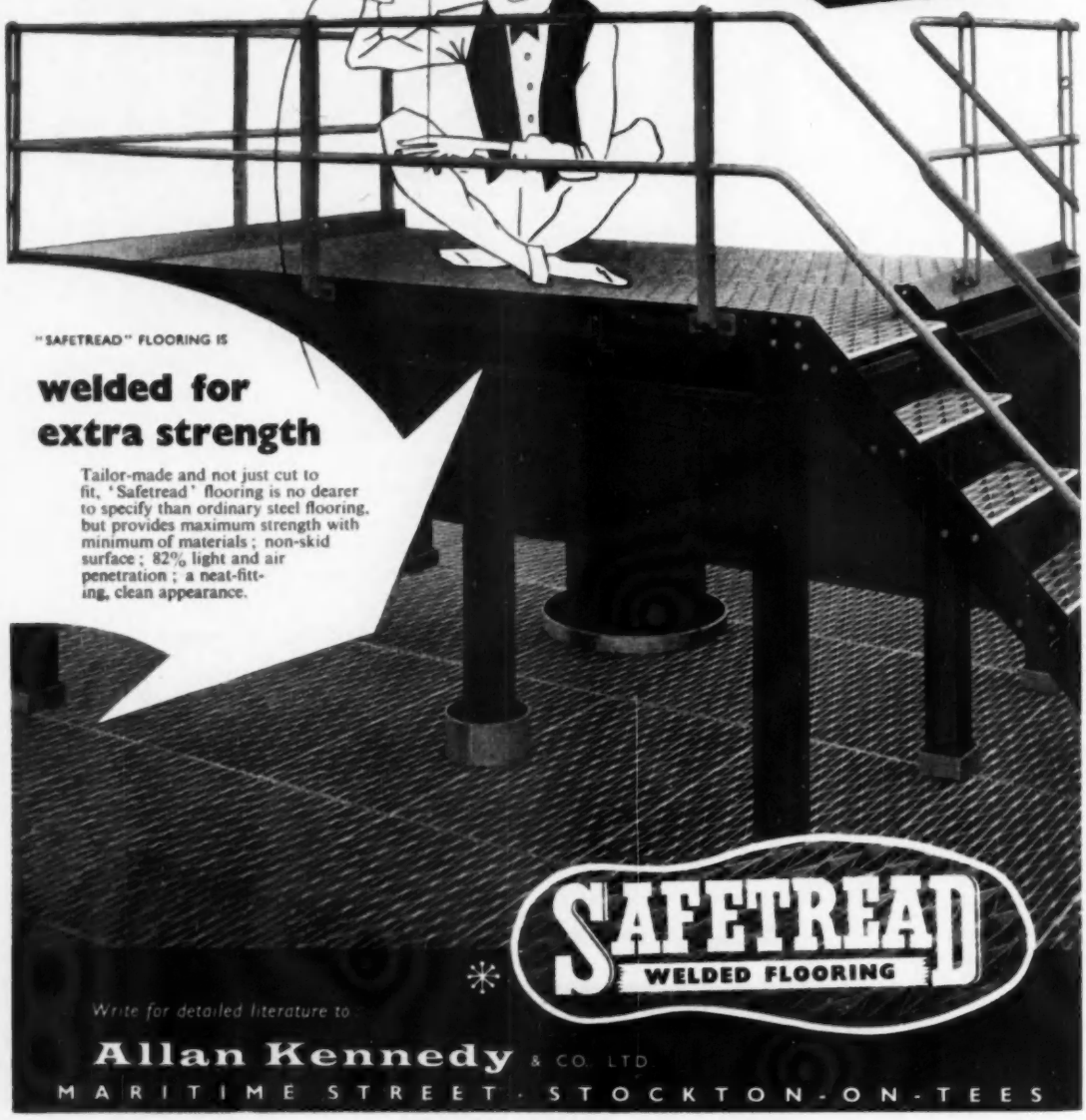

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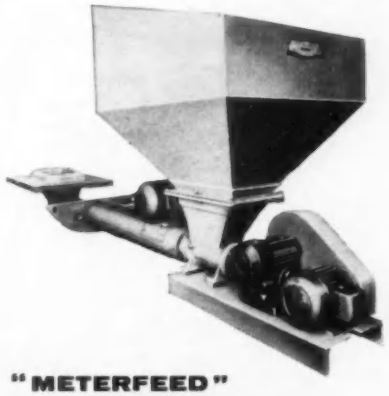

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This stoker has separate drive and fan motors which our "Custodian" Panel controls by cutting in the fan at a predetermined period before the drive and cutting out the fan after the drive has stopped.
The "Meterfeed" Underfeed Stoker is designed for the utmost fuel economy **without smoke** and is available in a full range of sizes in both hopper and bunker feed models and suitable for boiler, kiln and furnace application. All models embody the controlled feed principle.

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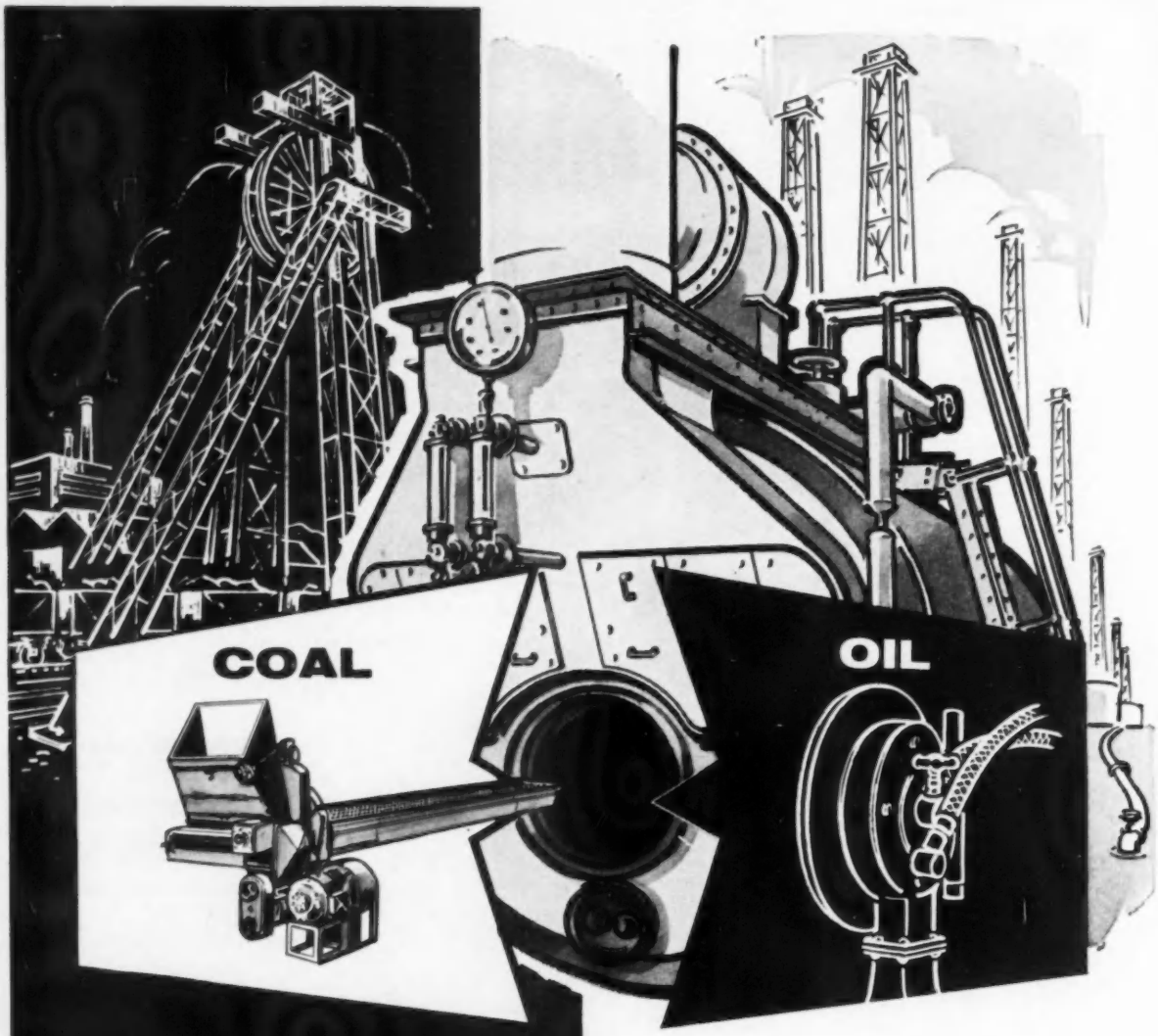

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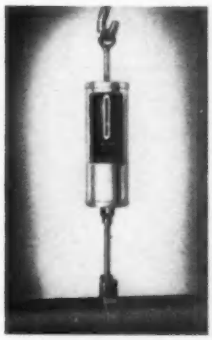
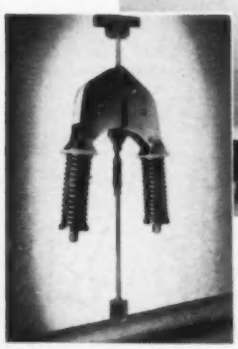
Ferrybridge " B " Power Station. Central Electricity Generating Board, Yorkshire Division. H.P. Steam pipes supplied and installed by Stewarts & Lloyds Ltd.



Leibfried Red Top Pipe Supports for loads from 100 to 5,000 lbs. and total travel of 3".

Conventional type " Con-Ten " Supports for loads up to 2 tons with a total vertical movement up to 12".



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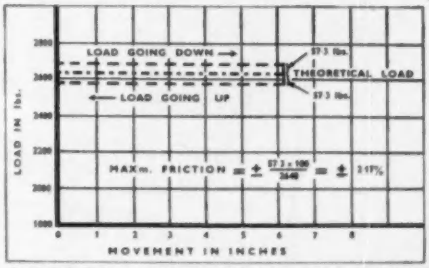

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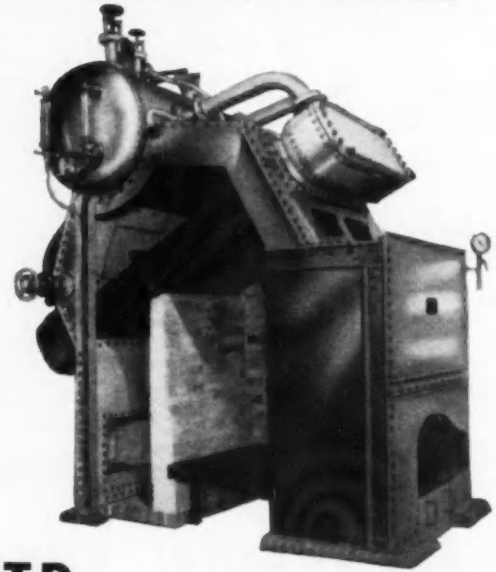

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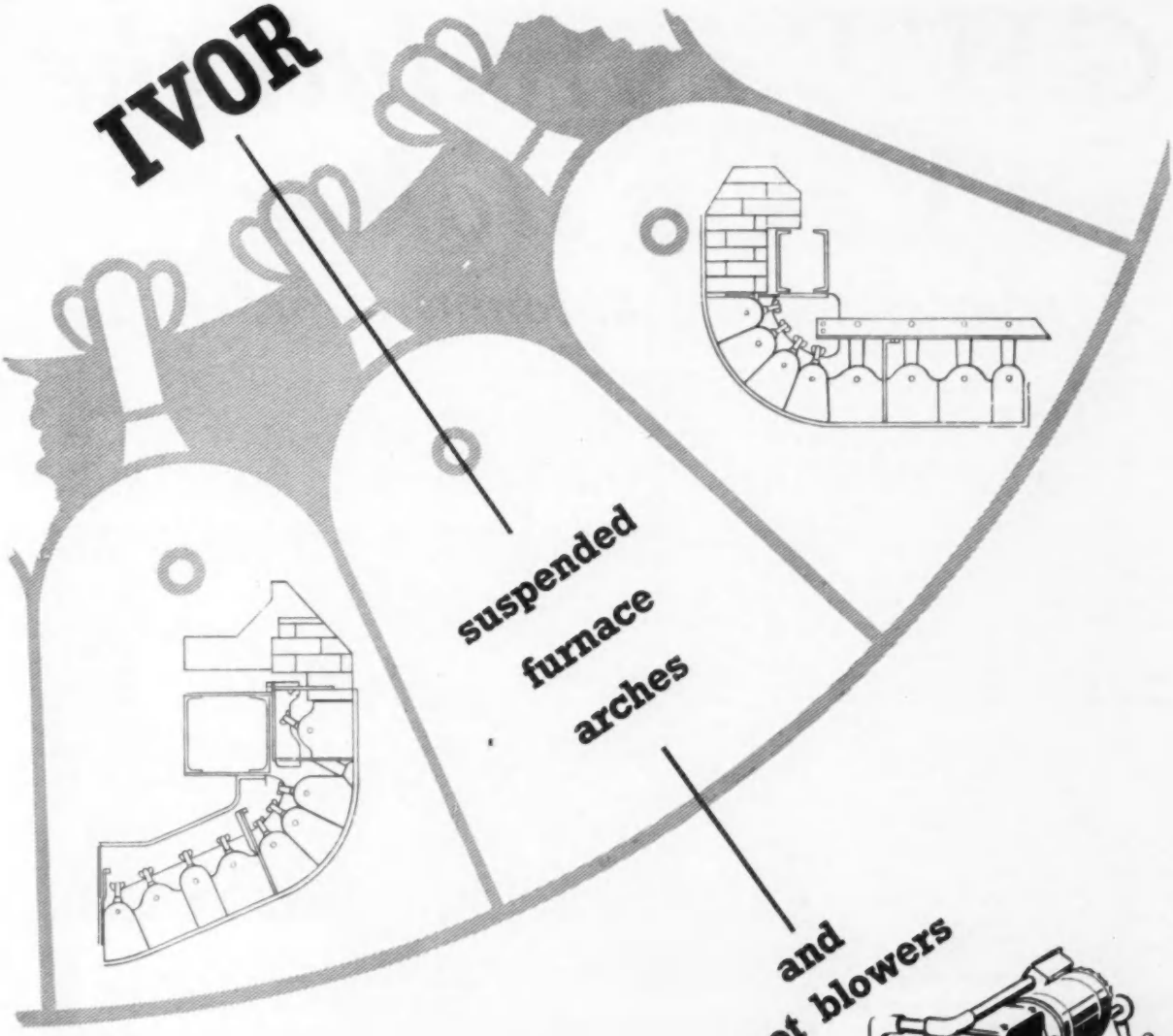

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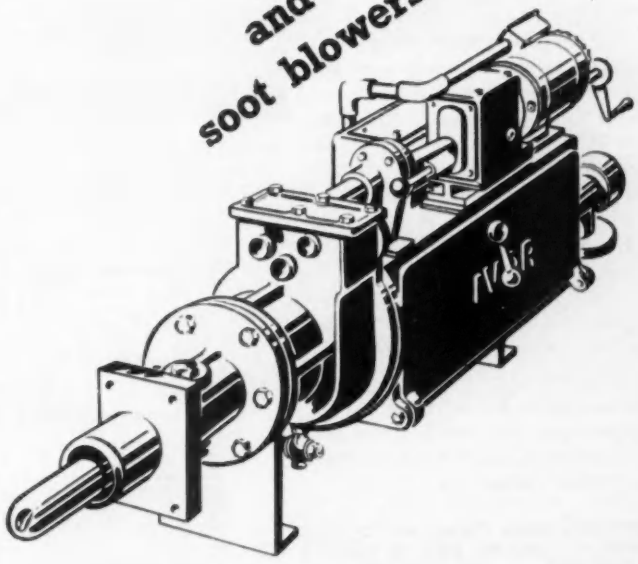

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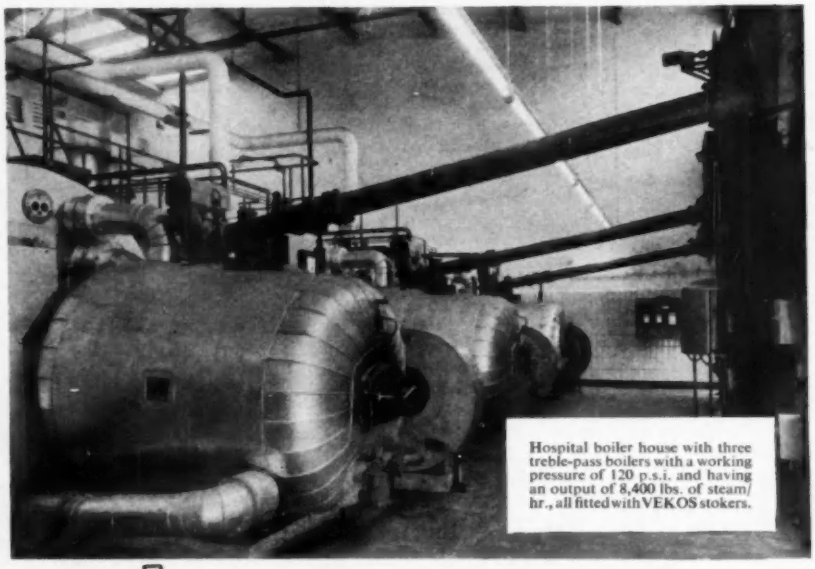
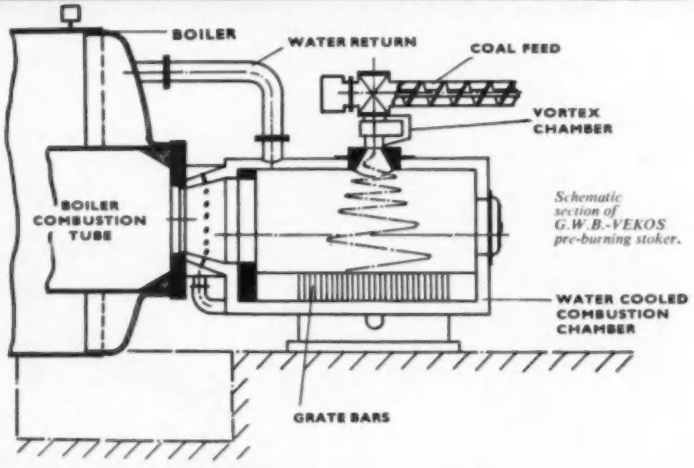


Hospital boiler house with three treble-pass boilers with a working pressure of 120 p.s.i. and having an output of 8,400 lbs. of steam/hr., all fitted with VEKOS stokers.



Schematic section of G.W.B.-VEKOS pre-burning stoker.

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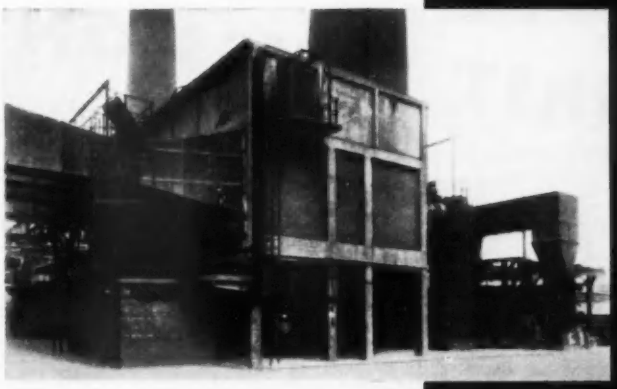
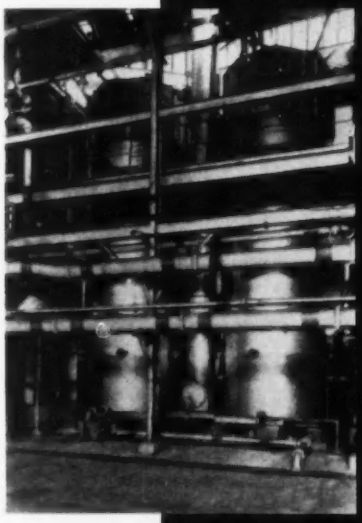


FLY-ASH INSTALLATIONS

One of the four three-section Holmes-Elex Electrical Precipitators installed after the pulverised fuel fired boilers at the Billingham Works of Imperial Chemical Industries Limited.

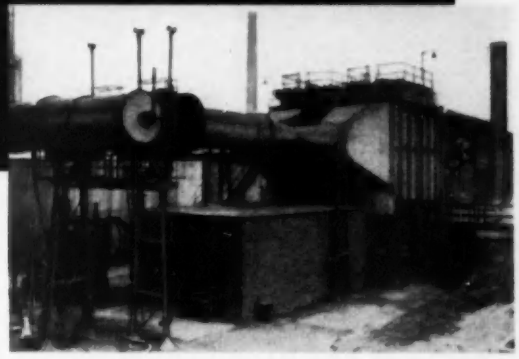


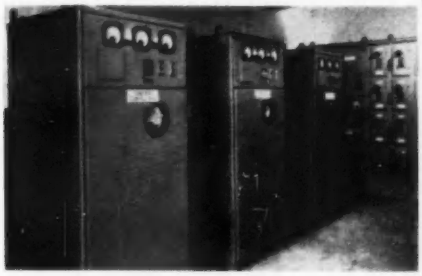
CHEMICAL INDUSTRY

Holmes-Elex Electrical Precipitators removing acid mist fumes resulting from the manufacture of sulphuric acid at the Trafford Park Works, Manchester, of Messrs. Courtaulds Limited.

IRON & STEEL INDUSTRY

A two-section Holmes-Elex Electrical Precipitator installed for the final cleaning of blast furnace gas at the Scunthorpe Works of the Appleby-Frodingham Steel Company (Branch of the United Steel Companies Limited).





ELECTRICAL EQUIPMENT

All electrical equipment used in conjunction with Holmes-Elex Electrical Precipitators is supplied by The Electric Construction Company Limited.

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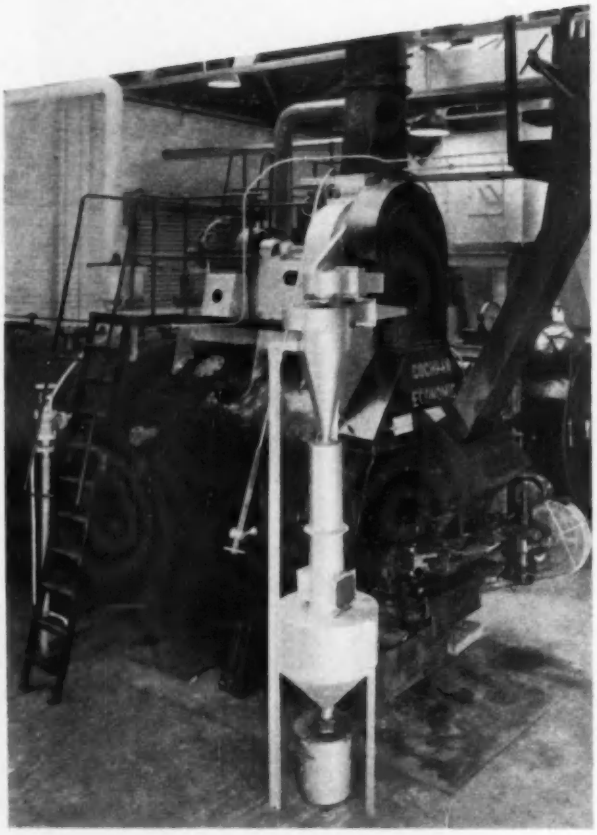

A Sturtevant "Newgate" Collector being used with a Cochran Economic boiler.

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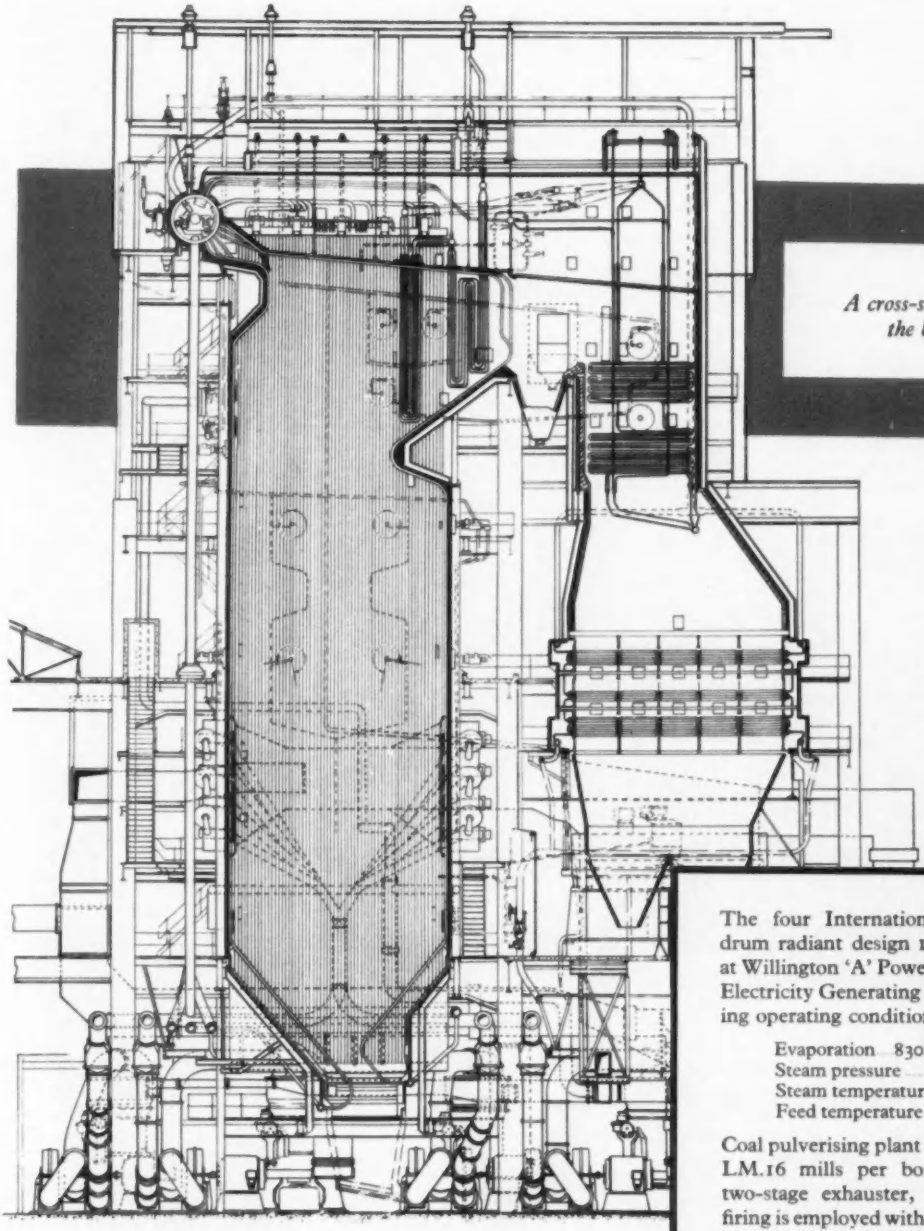

A cross-section of one of the boiler units

The four International Combustion single drum radiant design 100 MW units installed at Willington 'A' Power Station of the Central Electricity Generating Board have the following operating conditions :—

Evaporation	830,000 pounds per hr.
Steam pressure	1600 p.s.i.
Steam temperature	1060° F.
Feed temperature	400° F.

Coal pulverising plant comprises four Lopulco LM.16 mills per boiler, each swept by a two-stage exhauster, and tangential corner firing is employed with oil burners for lighting-up and to carry light loads.

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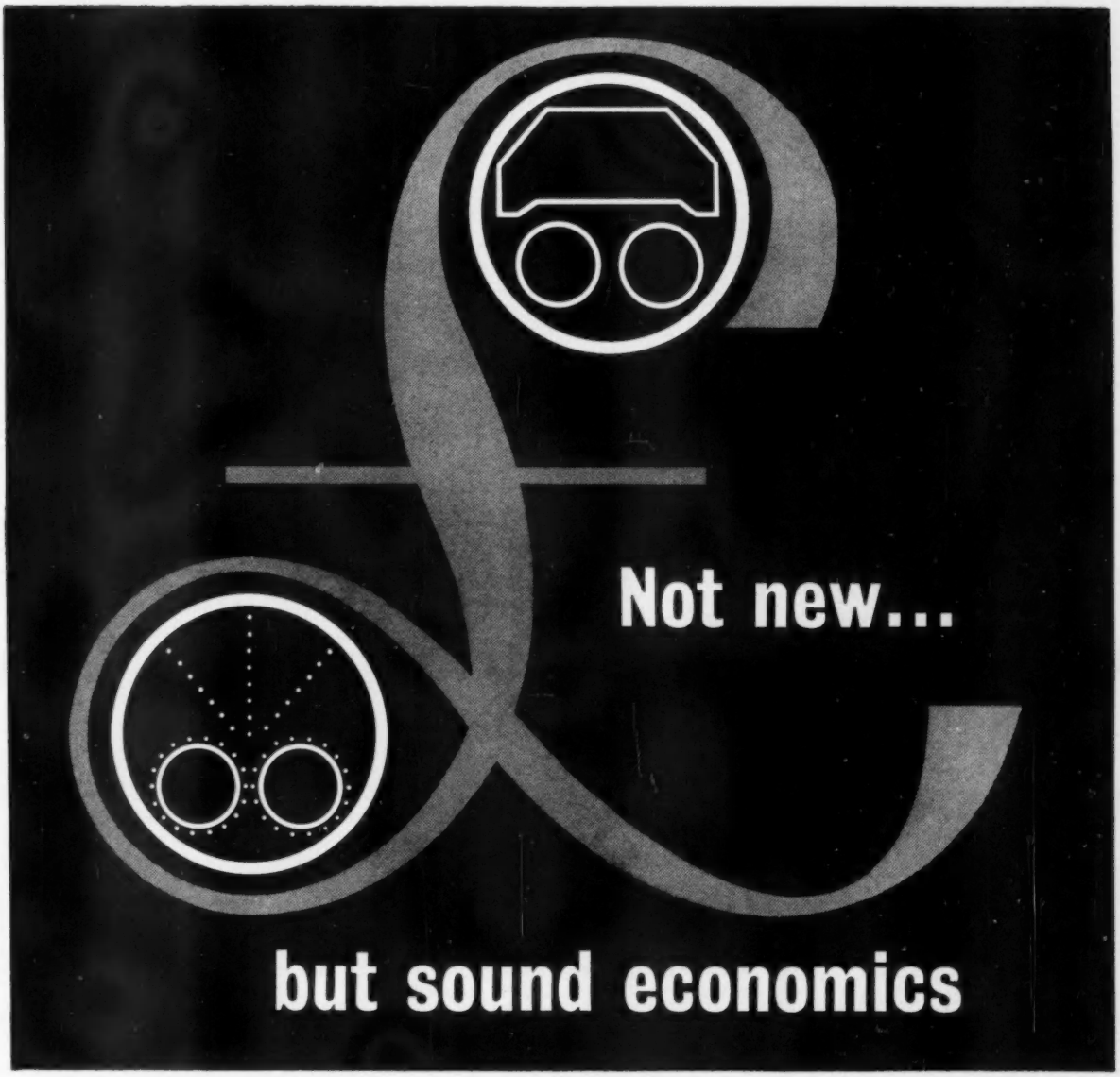

The average efficiency of Lancashire boilers in use in this country is something less than 65 per cent. The average efficiency of Richardsons Westgarth Economic boilers is between 80 and 85 per cent.

What does this mean in terms of fuel costs? The boiler most usually met with in industry is one evaporating about 8,000 lb. of saturated steam an hour at about 150 lb. per square inch. Assume it is steaming for some 6,000 hours a year then at 65 per cent the bill will be around £12,300 per annum, but at 85 per cent the bill will be reduced to about £9,700. That's a saving of £2,600 per annum—enough to pay for a Richardsons Westgarth Economic boiler of this size in 3½ years!

We make these Economic boilers with outputs of 3,000 to 24,000 lb. an hour. They may be welded or rivetted; two pass or three pass; designed to burn solid fuel or oil, and fully automatic if you wish. Up to 15,000 lb. an hour they can be built as completely self-contained steam raising units.

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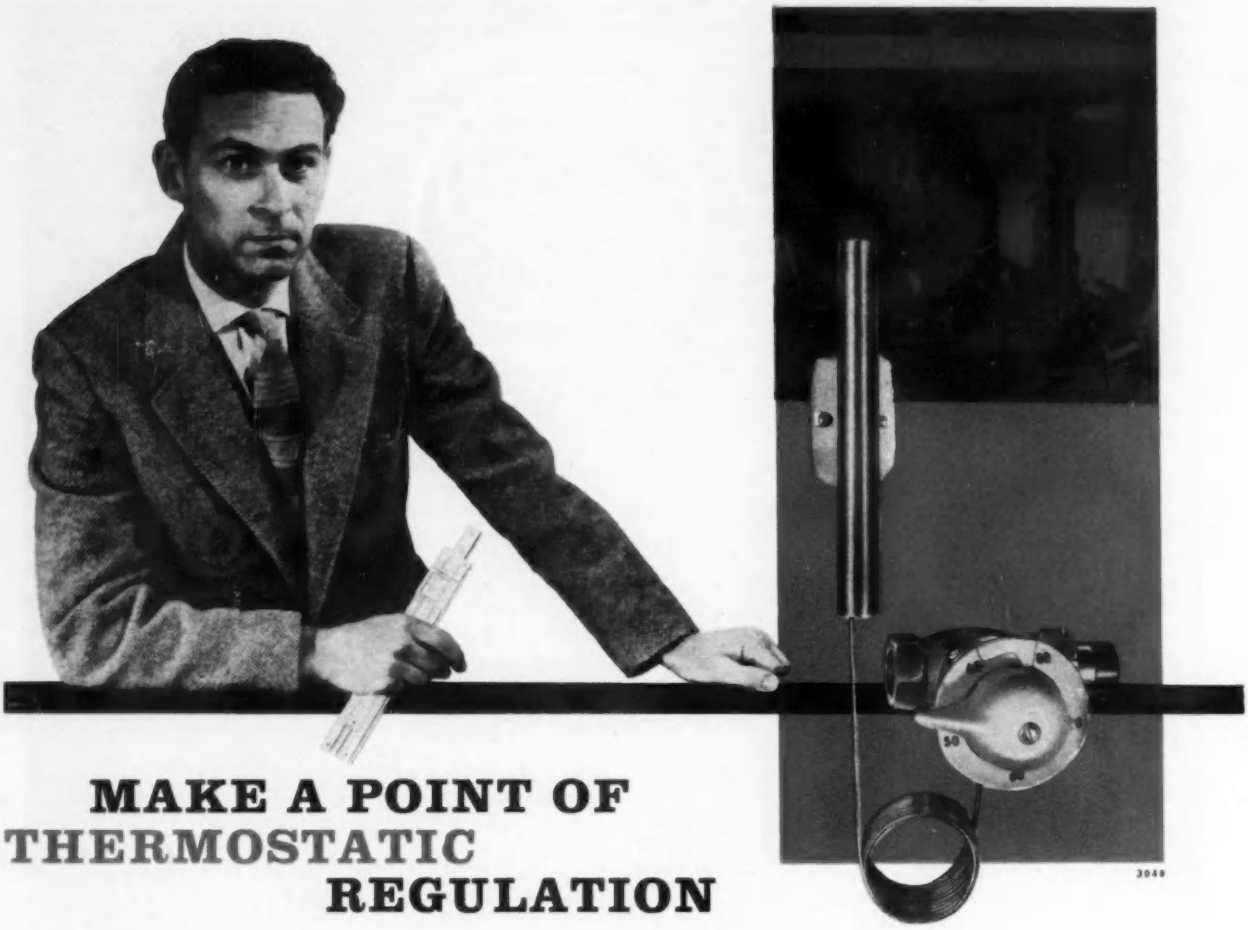

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When the Danfoss valve is set to the temperature you want, it automatically regulates the supply of hot water (or steam) to the radiator.

The Danfoss valve ensures good economy, thus being a luxury that pays for itself.

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

OCTOBER 1959

VOLUME 74. No. 10

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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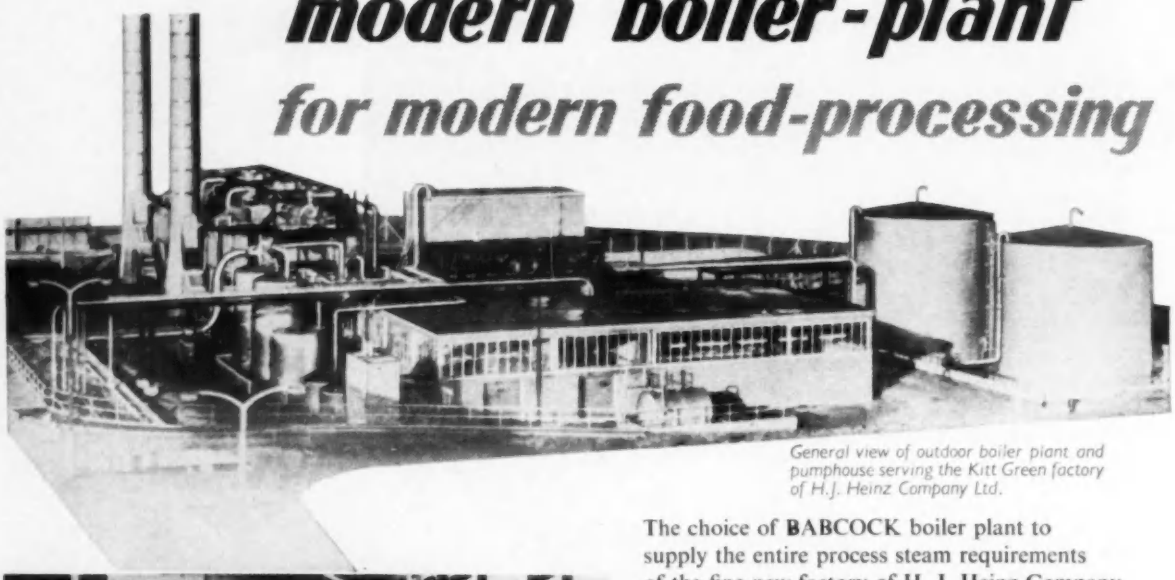
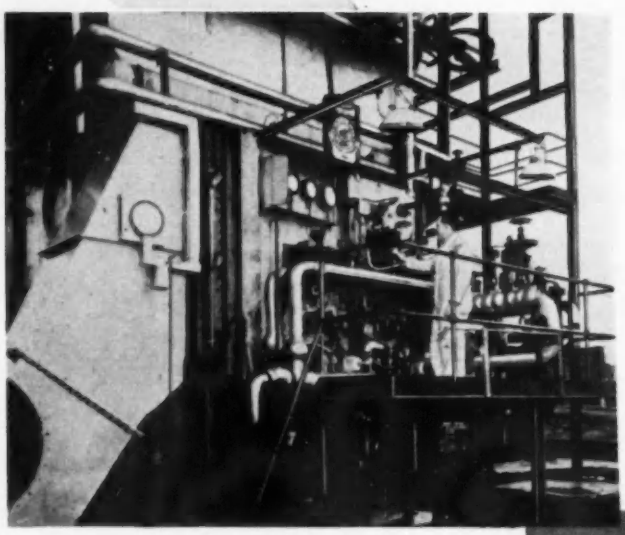


General view of outdoor boiler plant and pumphouse serving the Kitt Green factory of H.J. Heinz Company Ltd.

The choice of **BABCOCK** boiler plant to supply the entire process steam requirements of the fine new factory of H. J. Heinz Company Ltd. at Kitt Green, largest factory of its kind in Great Britain, again links two famous names, for Babcock steam plant serves a number of H. J. Heinz Company installations both in this country and abroad. The three boilers at Kitt Green are oil-fired Type FP (Integral-Furnace) units in a fully outdoor installation, requiring no boiler house. Each unit has a rated capacity of 50,000 lb. of saturated steam per hour at 200 lb./sq.in. Bailey automatic control is provided and the contract with Babcock & Wilcox included also the supply of steam and feed pipework, oil storage tanks, Y-jet oil burners, oil pumping-and-heating plant and other equipment; typifying the comprehensive steam-raising service offered to industry by Babcock.



Firing platform of one of the three Babcock outdoor boiler units, showing the five Y-jet oil-burners.

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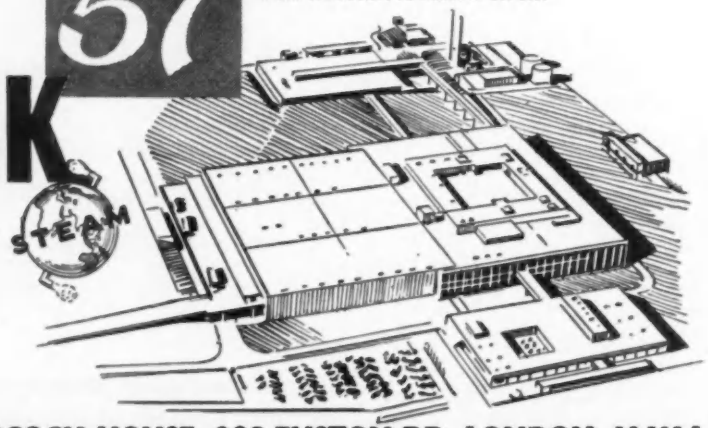
Main contractors A. Monk & Co. Ltd.

BABCOCK

Linking two famous names



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ELECTRICITY REPORTS

THE first annual reports and accounts (January 1st, 1958-March 31st, 1959) of the two statutory corporations set up by the Electricity Act of 1957—the Electricity Council and the Central Electricity Generating Board—were published recently. It will be recalled that the Electricity Council is the medium for central consultation and formulation of the general overall policy for the electricity supply industry in England and Wales. Both the generation and distribution sides of the industry are represented on the Council, the membership of which comprises a chairman, two deputy-chairmen, and numbers among its members all the chairmen of the Electricity Area Boards, and the chairman and two other members of the Central Electricity Generating Board. The main functions of the Council are to advise the Minister of Power on questions affecting the supply industry, and " to promote and assist the maintenance and development, by Electricity Boards in England and Wales, of an efficient co-ordinated and economical system of electricity supply."

The Central Electricity Generating Board owns and operates the 238 public supply power stations and the main transmission lines connecting them in England and Wales. The C.E.G.B. supplies electricity to the 12 Electricity Boards, which are, in turn, responsible for nearly all the distribution and sales of electricity to consumers—the total number at the end of the year covered by the report being 15.183 million, an increase of 315,699 (or 2.1 per cent.) over the previous year.

At March 31st this year the total installed generating capacity in the 238 power stations was just over 25,409-MW, and the total maximum output capacity with all plant in service 23,400-MW. Plans have been made by the Board to increase the generating capacity by more than 50 per cent. during the six calendar years 1959-64. These plans cover a total of 33 new power stations, and new sections and extensions to power stations, and represent a net addition of some 10,350-MW of output capacity. Altogether, some 12,350-MW of new plant are expected to be provided, but approximately 2,000-MW of old plant, which is unserviceable or uneconomic, are expected to be shut down to make way for the installation of new plant. New plant commissioned in 15 power stations during 1958-59 made available an additional output-capacity of 1,057-MW (1,400,000 h.p.).

For the coal industry, perhaps the most significant part of the Council's Report is that of the net output capacity planned for the end of 1964—33,600-MW—approximately nine-tenths will be generated in conventional, mostly coal-burning, plant, and only about one-tenth from nuclear stations. Thus, in addition to the revision of the oil-burning programme outlined in the Annual Report for 1957-58, whereby the number of oil-burning stations was reduced from 17 to 14, it was decided that further amendments would be made; and certain stations would remain " coal-fired " for extended periods, instead of being converted to oil-firing. The planned programmes, therefore, provide for an increase in annual coal consumption from 42 million tons in 1958 to 50 million tons in 1964.

Approximately 91,750 million units of electricity were generated at the power stations in England and Wales in 1958-59—this being 5.9 per cent. more than in the previous year. Of the total units generated, 99.82 per cent. were produced by steam plant using coal, coke breeze or oil as fuel. Improvement in thermal efficiency of generation has continued, and from the 1947-48 average efficiency figure of 20.91 per cent. for the steam power stations as a whole, the average thermal efficiency has now reached 26.10 per cent.

At a press conference, when the two reports were discussed, Sir Christopher Hinton, Chairman of the C.E.G.B., said that one of the main problems claiming their attention concerned the long-term fuel policy of the supply industry. For the sound development of the power programme, it was necessary to evolve a balance, on an economic basis of the three main fuels available to power stations in England and Wales—coal, oil and nuclear. In looking further ahead, the Board was confronted with a pressing problem in trying to strike an economic balance between the three fuels for the plant programmes covering 1966-76. One factor that tended to upset earlier estimates was the very rapid technical advances that were being made in conventional stations: the point at which the generation costs of nuclear power stations would " break even " with those of conventional stations might be as late as 1970.

It is as well to acknowledge that as long as adequate coal supplies are available, the choice between coal and nuclear fuels must, in the long term, be made on an economic basis. At present, the conventional stations are setting the pace.

Points and Pointers

STEEL SPECIFICATIONS A series of summary sheets of the British Standards for steel is being prepared jointly by the British Standards Institution and the British Iron and Steel Federation. They will be published in English, in both British and metric units, and in French, German, Portuguese and Spanish. Some 20 sheets in each of the five languages are being prepared, and are being grouped so that materials for similar products are shown on one sheet. It is hoped that "the distribution of these summary sheets will encourage the use abroad of British materials." In addition, tables are being prepared showing comparisons between American, British and German steels. They will be in three parts, under the headings of carbon and low alloy steels, alloy steels, and steels generally, specified by mechanical properties. This information is included in the annual report of the British Standards Institution. A section of this report covers the technical work of the international organisations concerned with standardisation. This contains a brief record of the subjects under discussion, and the progress made, in the technical committees during the year ended March 31st, 1959. With regard to machine tools, the International Standards Organisation committee approved their machine tool test code, which is now being prepared as an I.S.O. recommendation. This is afterwards expected to become the basis for additional work in the United Kingdom on the testing of machine tools. Three draft recommendations for tool shank tapers, lathe centres and lathe tool posts were also approved.

YOUNG CANADIANS STUDY BRITISH ENGINEERING Forty young Canadian engineers, mostly graduates direct from Canadian universities, recently arrived in the United Kingdom under the Athlone Fellowship Scheme, and were welcomed on behalf of the Secretary of State for Commonwealth Relations by Sir Alexander Clutterbuck, Permanent Under-Secretary at the Commonwealth Relations Office. The Canadian High Commissioner in London, H.E. The Hon. G. A. Drew, the Agents-General for the Canadian Provinces, and members of the Athlone Fellowships Managing Committee attended the reception. The Fellowships are of two years' duration, and the scheme is financed by the Board of Trade. In London the Canadians were provided with temporary accommodation at Nutford House, Brown Street, W.1, during a short introductory course which they took at the British Council Overseas Students Centre, 3, Hanover Street, London, W.1. This course provided a general briefing on accommodation, banking facilities and the National Health Service. It also provided a general introduction to British industrial resources, trades unions, industrial relations and social structure. The Athlone Fellowships are available for works training in United Kingdom industrial organisations, or training with consulting engineers, or post-graduate study in a United Kingdom university, college or research establishment, or a combination of any of these. The object of the scheme is to enable selected Canadian engineers to obtain first-hand information of the scope and quality of engineering research, development, design and production in the United Kingdom. At the same time, the scheme enables the Fellows to meet people in the United Kingdom, and become acquainted with their way of life, thus fostering understanding between the two countries, and building the basis upon which trade across the Atlantic can be increased in both directions. Since the Athlone Fellowship Scheme was founded eight years ago, some 350 Canadian engineers have taken advantage of the Athlone Fellowships to spend two years in the United Kingdom, doing post-graduate studies in universities and technical institutions, in engineering works, with consulting engineers and in research establishments. This is the ninth party of Canadians to come to this country under the scheme.

PILOT-SCALE GAMMA RADIATION PROCESSING PLANT Research work by the United Kingdom Atomic Energy Authority on the commercial-scale use of intense radiation for industrial purposes has now reached the stage at which a pilot plant is being built for operation by the end of this year. The plant is expected to be the first of its kind and size in the world. The new plant is being built at the Wantage Radiation Laboratories for the Technological Irradiation Group of the Isotope Research Division, Atomic Energy Research Establishment. Work on the useful employment of the large quantities of radioactive material which will become available as a result of the nuclear power programme has been in progress for some years, and this new plant will enable industrial firms already investigating the technical merit and commercial potentialities of irradiated materials, to carry out full-scale trial runs of irradiation processes, such as the sterilisation of medical equipment and the disinfestation of packaged products. The entire plant occupies an area of approximately 10,000 sq. ft., and this includes storage of material both before and after processing, all the mechanical-handling plant as well as the irradiation cell which itself occupies roughly 1,000 sq. ft. including massive concrete shielding walls. The plant is based on a unit package size of approximately 1-cu. ft., and packages will be handled continuously and automatically from bulk store through the equipment and into the treated material store. To ensure full utilisation of the capital investment, particularly of the source, which is continually radiating and decaying, the plant will operate 24 hours per day. Carefully-designed interlocks and control devices are being incorporated to prevent any health hazard, and to ensure the correct radiation dosage. The cell has been designed to house half-a-million curies of Cobalt 60, but will be loaded initially with 150,000 curies, which will provide

a throughput of 7 megarad-tons per day. As an example, during 24 hours' operation, 3-tons of medical products or imported animal fibres could be rendered sterile, since a sterilising dose is of the order of 2½-rads. (The rad is the unit of measurement of the amount of energy transferred by radiation to unit weight of material.) The contract for the detailed design and construction of the mechanical handling and storage equipment of the pilot plant at Wantage has been placed with the Owen Organisation. The main companies within that group who are concerned, are the parent company, Rubery Owen & Co. Ltd., Darlaston, and Electro-Hydraulics Limited, Warrington. Other companies within the Group will also contribute. The design and manufacturing team built up by the Owen Organisation is working in close collaboration with the Engineering Division at Harwell, who have established the general design and specification to the requirements of the Technological Irradiation Group.

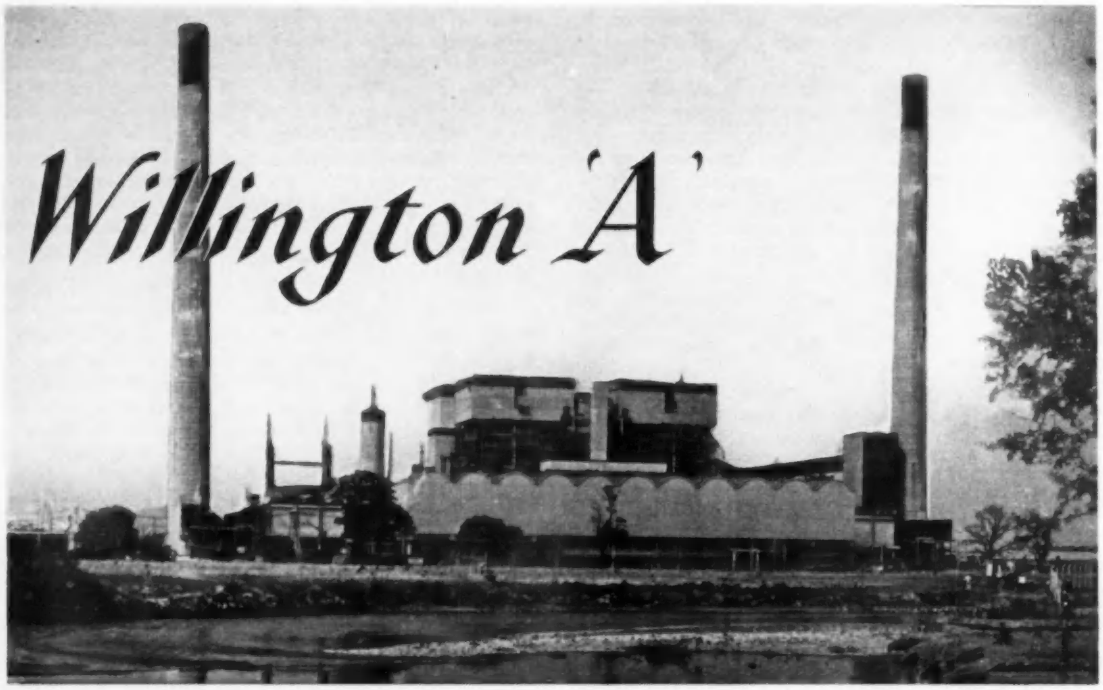
ALIGNMENT OF COMMON-WEALTH STANDARDS

Much useful progress towards the greater alignment of their industrial standards was made by the seven countries which took part in the recently-held Commonwealth Standards Conference in Ottawa. The conference, fourth of its kind, was attended by more than 70 representatives drawn from the industrial concerns and the standards organisations of Australia, Canada, India, New Zealand, Pakistan, South Africa and the United Kingdom. An observer was present from the Institute for Research and Standards, Dublin. Welcoming the delegates on behalf of the Government of Canada, the Hon. Gordon Churchill, Minister of Trade and Commerce, referred to moves in the Commonwealth, as well as internationally, aimed at creating new markets and expanding existing ones. The progressive steps taken to free the international movement of goods could be lessened in value if products were not in accordance with specifications acceptable to the purchaser, he said. The conference included three technical sessions, viz., on steel, air-receivers and cranes—all subjects of importance in intra-Commonwealth trade and therefore needing as close alignment as possible from the standards viewpoint—and a general session on some of the common policy problems facing Commonwealth standards organisations. Mr. H. A. R. Binney, Director of the B.S.I., took the chair at the general session, with Mr. F. A. Sweet, general manager of the Canadian Standards Association, acting as co-chairman. Chairmen for the technical sessions were *Steel*, Mr. E. W. Senior (United Kingdom); *Air Receivers*, Mr. W. A. Berriman (Canada); *Cranes*, Mr. John Baker (United Kingdom). The conference reviewed progress made on the technical subjects discussed at the Delhi meetings in 1957—cables, electrical equipment of machine tools, etc. There appeared to be need for further discussion on insulation thicknesses for rubber-moulded cables, but on other types of cables good progress was reported in the alignment of Commonwealth standards. The agreements on electrical equipment of machine tools were being implemented and this Commonwealth alignment was likely to be helpful in international discussions on this subject which were just starting. Further progress on safety of domestic electrical appliances awaited the completion of work in Australia. In the general session, views were exchanged on the problems of certification marking and approval schemes in regard to administration, control of quality, and publicity to promote acceptance of such marks and understanding of the independent assurance which they carried. In regard to the problems of inch and metric measures, procedures were discussed to reduce the inconvenience caused by the existence of the two systems and to achieve the maximum interchangeability of goods through the adoption of corresponding inch and metric sizes and standards.

COAL VERSUS OIL IN INDUSTRY

The National Coal Board is making special efforts to encourage British industry to maintain and to extend its use of coal. The steps to be taken were expounded at a Press conference held at the Board's London headquarters on October 1st, by Mr. R. H. E. Thomas, O.B.E., the Board's marketing member, who said that the principal objective was to restore some enthusiasm for the all-round use of coal in the various branches of industry. The Board is understandably concerned about the increasing use of oil as fuel by industry in general and, understandably, it must strive to regain some of the prestige that coal has lost during the past two or three years. Mr. Thomas said that in the industrial field, however, they do not know with any certainty how much coal they will be able to sell. Statistics show that in the first nine months of this year, industrial coal consumption was 2,000,000-tons less than in the comparable period of 1958 and that, according to the latest figures, undistributed stocks exceed 33,000,000-tons. The question, quite simply, is how successful they are likely to be in holding on to their business against the challenge of oil, and how much of the business already lost is likely to be won back. To accomplish this, the Board intends to provide an improved and comprehensive technical and general sales service and to publicise industrial coal in a way which will offset the feeling that oil is the fashionable fuel. In this publicity campaign, emphasis is to be given to individual coal-burning installations which are operating at high efficiencies. In order to support its propaganda plans, the Board has commendably reiterated its determination to improve the quality and consistency of the coal it offers. Mr. Thomas recalled that, since nationalisation, the Board have spent about £60 million on building 261 new coal-preparation plants. Between £25 million and £30 million a year was being spent on cleaning and preparing coal for the market, and about £10 million was being invested annually in new mechanical cleaning plant. Hand-cleaning, he added, was being eliminated for all but large coal above 6-in. to 8-in. in size and research in coal preparation was being carried out. Every effort was thus being made, Mr. Thomas declared, "to give the consumer the coal best suited to his particular purpose." From the industrial user's point of view, it would appear that the best incentive the Board can offer is better quality coal at the prices now ruling. The general level of coal prices has remained stable since the middle of 1957 and it was stressed at the conference that the Board hoped to maintain that stability unless circumstances completely beyond its control arise.

Willington 'A'



WILLINGTON "A" power station, operated by the Midlands and East Midlands Region of the Central Electricity Generating Board, and situated on the north bank of the River Trent, some six miles south-west of Derby, was officially opened on October 2nd, 1959, by His Grace, the Duke of Devonshire. Ultimately, the capacity of the plant installed on the site will be 800-MW. The "A" station, which is the subject of these notes, comprises four 100-MW turbo-alternator units of English Electric Co. Ltd. manufacture, and four pulverised-fuel-fired-boilers, each with a m.c.r. of 830,000 lb./hr. at 1,600 lb./sq. in. and 1,060 deg. F., supplied by International Combustion Limited. The "B" station will contain two 200-MW boiler/turbo-alternator unit sets, the capacity of each boiler being 1,400,000 lb./hr.

Coal supplies are received by rail, connections being provided to the new station from the main Derby to Burton line which passes to the north of the site. To the south is the River Trent, from which circulating-water is obtained, while the 135-kV and 275-kV switching stations, through which connections are made to the National Grid, are located west of the station. Furnace bottom ash is disposed of by road transport, the initial tipping area being a disused gravel pit near Repton. Dust is pumped to another gravel pit at Stretton, some four miles west of the Willington site.

The layout of the main station buildings does not conform to conventional practice, the underlying principles behind the arrangement adopted being as follows:—(1) The four boiler units are arranged in square formation with a central mill aisle and coal bunkers. (2) Two separate turbine houses, each accommodating two 100-MW turbo-alternator units, are situated on opposite sides of the boiler house. This arrangement was decided upon to facilitate the installation of the stators by the use of a demountable lifting rig,* with the result that it was then only necessary to provide a crane and structure of a size suitable for handling the heaviest maintenance lift. (3) Two air-conditioned plant control rooms are situated centrally between each pair of boiler/turbo-alternator units.

Messrs. Ewbank & Partners Limited were the engineering consultants for the new station, and Sir William Halcrow & Partners civil consultants, the main civil engineering work being carried out by Marples, Ridgeway & Partners Limited. Edward Wood & Co. Ltd. were responsible for the structural steelwork. The two 425-ft. high reinforced-concrete chimneys, serving the four boiler units, were constructed by Tileman & Co. Ltd.

Coal-handling plant

The coal-handling plant installed by The New Conveyor Co. Ltd., Smethwick, is one of the largest of its kind in this country, being designed to handle 1,400-tons/hr. of coal. The storage area has a capacity of 500,000-tons.

Mixed coal having a maximum size of 2-in. cube, and which is crushed as necessary to pass a $\frac{3}{4}$-in. mesh screen before delivery to the storage area, and/or the boiler bunkers, is brought to the site by rail wagons with capacities varying between 12$\frac{1}{2}$ and 24$\frac{1}{2}$-tons. It is discharged into either of two reinforced-concrete hoppers by means of four side-discharge tipplers of Strachan & Henshaw Limited manufacture. Wagon-marshalling gear of the power-operated "Beetle"-type also supplied

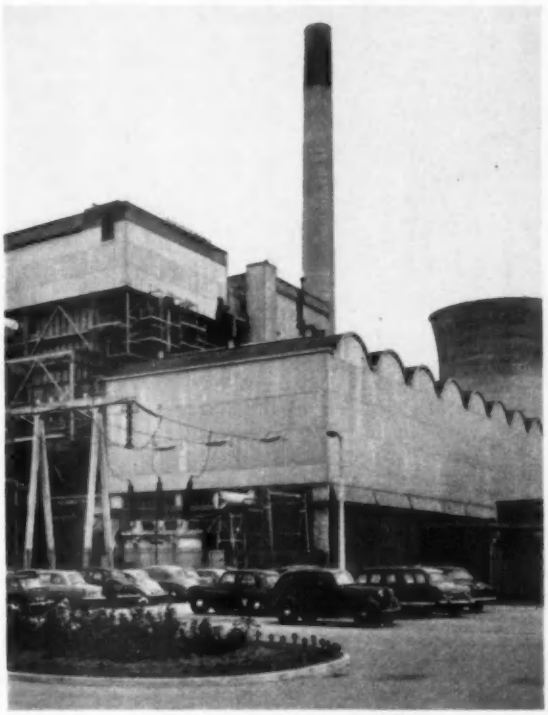
**For illustrated description of lifting rig see "Engineering and Boiler House Review," August, 1959, pp. 250-253.*

by Strachan & Henshaw, is provided on both the in-haul and out-haul side of each tippler, and is designed to handle up to 15 wagons per hour. From the tippler hoppers, the coal is transferred by eight electric vibrating feeders, supplied by G.E.C. (Fraser & Chalmers Engineering Works), each with a capacity of 175-tons/hr. via belt conveyors to the screening and crushing house. Between these points a probe-type magnetic separator removes tramp iron, etc. Inside the screening and crushing house the conveyors discharge to four International Combustion Products Limited mechanical vibrating screens, the throughput falling into a transfer hopper below, the oversize first passing to either of two coal-crushers supplied by British Jeffrey Diamond Limited. From the transfer hopper, coal is conveyed either direct to the boiler bunkers or alternatively to stock.

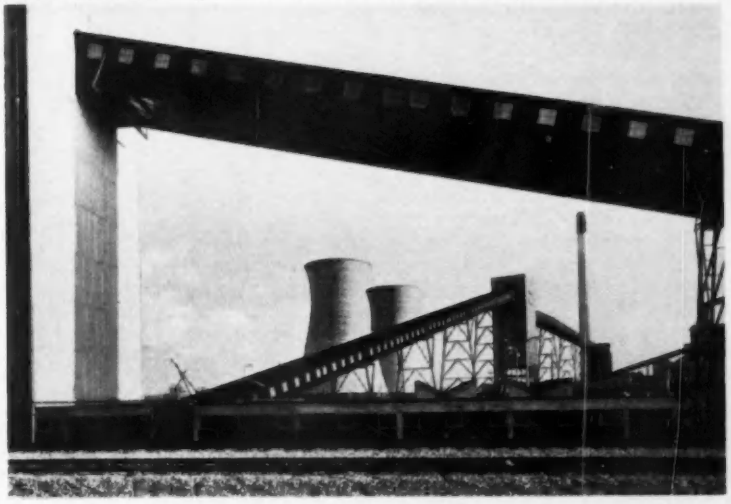
When delivered to store, coal is conveyed to a boom-stacker, and the piles formed by the stacker spread over the area by bulldozers, which are also used to reclaim coal into either of two reclaiming hoppers, from where it is delivered back to the transfer hopper (the conveyor between these points being reversible) and then to the boiler bunkers. Trash-screens are installed prior to the boiler bunkers, and automatic continuous weighers, supplied by Adequate Weighers Limited, are provided to indicate the total weight of coal delivered to the station. Facilities are also provided for automatic coal-sampling for laboratory test purposes.

All conveyor drives are by squirrel-cage electric motors coupled to totally enclosed "Radicon" worm gears, by Vulcan-Sinclair traction-type fluid couplings ranging from size 17.75, transmitting 30-h.p. at 985-r.p.m., to size 26, transmitting 170-h.p. at the same speed, supplied by Fluidrive Engineering Co. Ltd. Altogether some 29 Vulcan-Sinclair fluid-couplings of the traction-type were provided to serve the coal-handling plant, these being used, in addition to the belt-conveyor drives, for the drive units of the wagon tipplers, wagon-marshalling gear, and coal-crushers. In the case of the wagon-tipplers and marshalling-winches, the ability of the fluid-coupling to limit the torque transmitted to a safe amount in the event of the drive being stalled, makes this a particularly suitable application of Fluidrive. The electric motors used throughout the handling installation were supplied by Laurence, Scott & Electromotors Limited. These have ratings of up to 185-h.p. and are mainly of the "Emcol" totally-enclosed fan-cooled type.

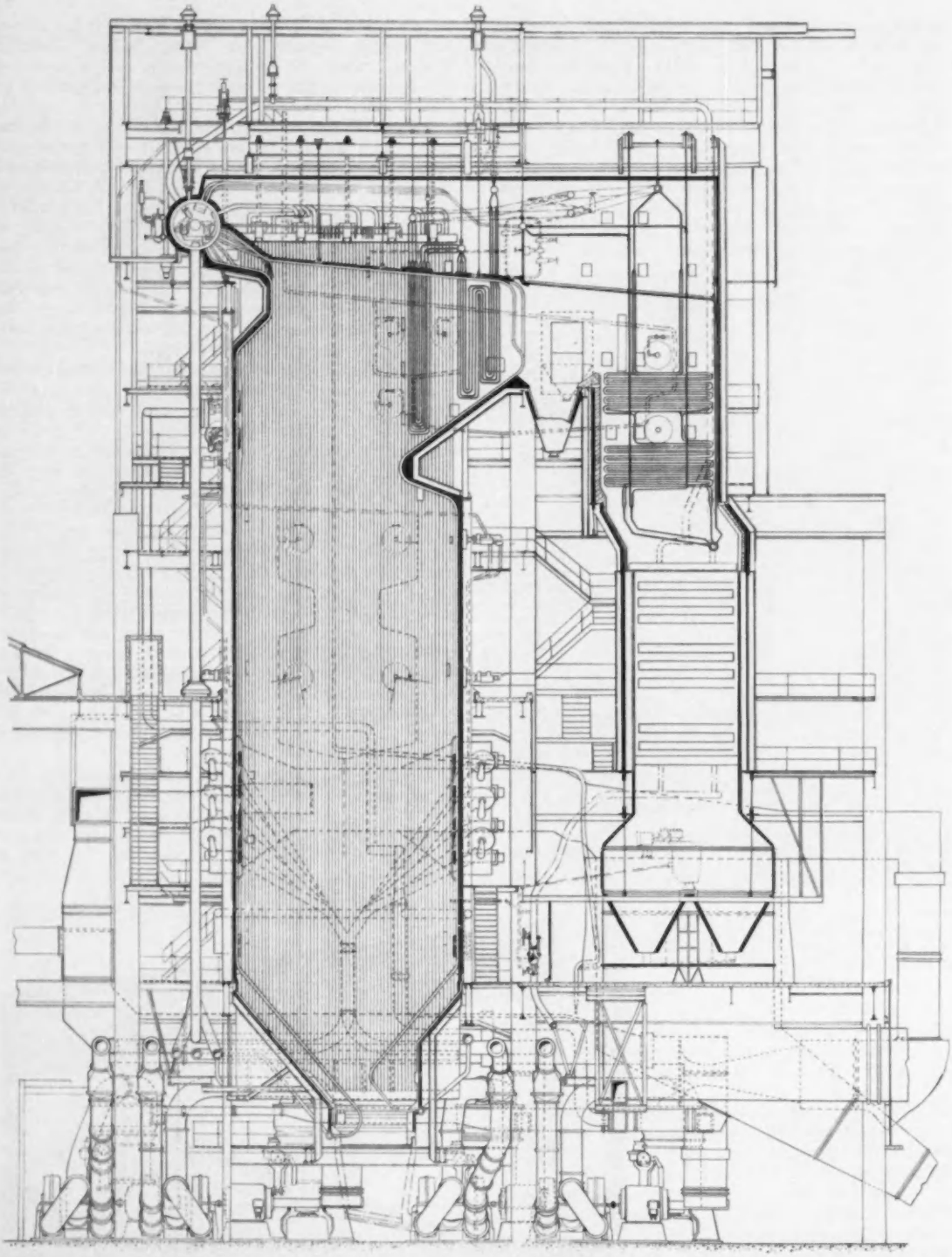
Provision has been made in the design of the coal-handling plant, for the addition of further tipplers, and conveyor extensions to the "B" station boiler bunkers, and for a further reclaiming belt delivering into the coal storage area junction tower. All the plant at present installed between these points is of sufficient



(Above). Exterior view of No. 1 turbine house showing lightweight concrete barrel-vault roof construction. At left is seen one of the four boilers which is of semi-outdoor construction.



(Right). Part of the coal-handling plant which has been designed to serve both the "A" and "B" stations, and has a capacity of 1,400 tons/hr.



CROSS SECTIONAL ARRANGEMENT OF ONE OF THE FOUR LOPULCO 830,000 LB./HR. SINGLE-DRUM RADIANT BOILERS WHICH WERE SUPPLIED BY INTERNATIONAL COMBUSTION LIMITED. THEY ARE CORNER-FIRED PULVERISED-FUEL UNITS OPERATING AT A PRESSURE OF 1,600 LB./SQ. IN. AND A STOP-VALVE TEMPERATURE OF 1,060 DEG. F.

capacity to service both the "A" and "B" stations.

The coal pulverising plant is of International Combustion Limited manufacture, and comprises four 16-ton/hr. capacity Lopulco-type LM 16/2 suction mills per boiler, each driven through reduction gearing by a 185-h.p. electric motor at 1,480 r.p.m. When firing East Midlands coal having a net c.v. of 9,700 B.Th.U./lb., and with a 14 per cent. ash content and a moisture content also of 14 per cent., three mills can supply the necessary coal at normal boiler rating, the fourth acting as standby. Each mill is air-swept by a DE 49/11 exhauster, and following standard Lopulco practice, each mill delivers a pulverised fuel/air mixture via the separator to one burner nozzle at each corner of the furnace, the nozzles being arranged to fire tangentially to an imaginary circle at the centre of the combustion chamber. The exhausters are driven by N-S variable-speed a.c. motors, rated at 305/82-h.p., and 1,470/960 r.p.m. Similar motors are provided for the mill feeders and separators, those for the former being rated at 2/0.28-h.p. and 2,200/314 r.p.m. and for the latter 10/3-h.p., and 2,200/880 r.p.m. These together with the actual mill motors were supplied by Laurence, Scott & Electromotors Limited.

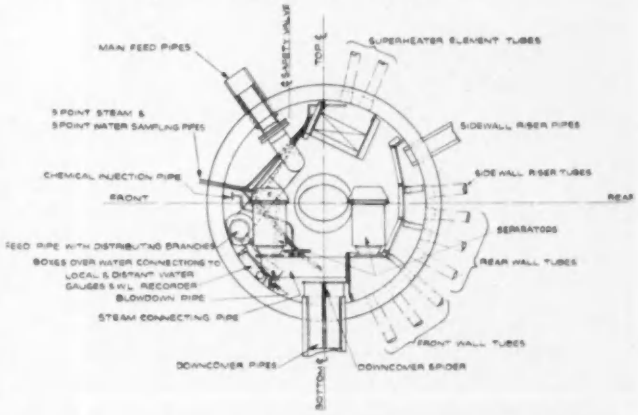
An interesting feature of the pulverising plant at this station is the installation of a prototype Lopulco three-roll pressure mill on No. 4 boiler unit. This is a prototype of the design for the 550-MW unit boiler for Thorpe Marsh power station, which International Combustion Limited are to install for the Central Electricity Generating Board, and it is smaller than the ultimate production model. In co-operation with the C.E.G.B. this prototype mill has been installed at Willington, to provide test information over a trial period, in addition to operating data which will be of great value for the Thorpe Marsh contract. Preliminary details of this three-roll Lopulco design were published in the December, 1958, issue of *Engineering and Boiler House Review*.

Each boiler is equipped with 12 standard-type F.F.1/80 initiators; six placed in the front wall adjacent to the p.f. coal burners, and six in the rear wall. They were supplied by Fuel Firing Limited, and are used for raising pressure on the boilers from a cold condition to full working pressure, when burning 960 seconds oil of Redwood No. 1 viscosity. When pressure has been raised, the same initiators are used for ignition of the coal. Each initiator has its own integral fan so that the fuel/air ratios and velocities are at a fixed value to enable a very high degree of combustion efficiency to be attained so that there is no smoke emission, or carbon or oil deposits, anywhere in the boiler unit. The initiators are, of course, fully-automatic and remotely operated, and embody patented means of retraction of the burner from the furnace to afford complete protection from the effects of the pulverised coal flame when the initiators are not in use. Ignition of the initiator flame is achieved by a patented 12-V, high-heat release, igniter to give rapid and reliable establishment of the flame.

Boiler plant

The four boilers supplied by International Combustion Limited are, as previously mentioned, each designed for an m.c.r. of 830,000 lb./hr., at 1,600 lb./sq. in. and 1,060 deg. F. These units are of the Lopulco single-drum radiant design, with furnaces arranged for corner-firing through International-Combustion tilting-burners. They are of semi-outdoor construction, the building structure, from which the boilers and associated plant are supported, also serving as a partial roof.

Close-pitched, finned tubes are used to form a completely water-cooled combustion chamber, with a volume of 73,300-cu. ft., giving an effective heating surface of 15,455-sq. ft. The gases leave the furnace through an exit so designed that the high-temperature secondary-section of the superheater is screened from direct combustion radiation. After traversing the high-temperature section of the superheater, the gases pass vertically downwards through the primary-section, then to the economiser, air-heater, electrostatic precipitator, and finally are discharged to the chimney.

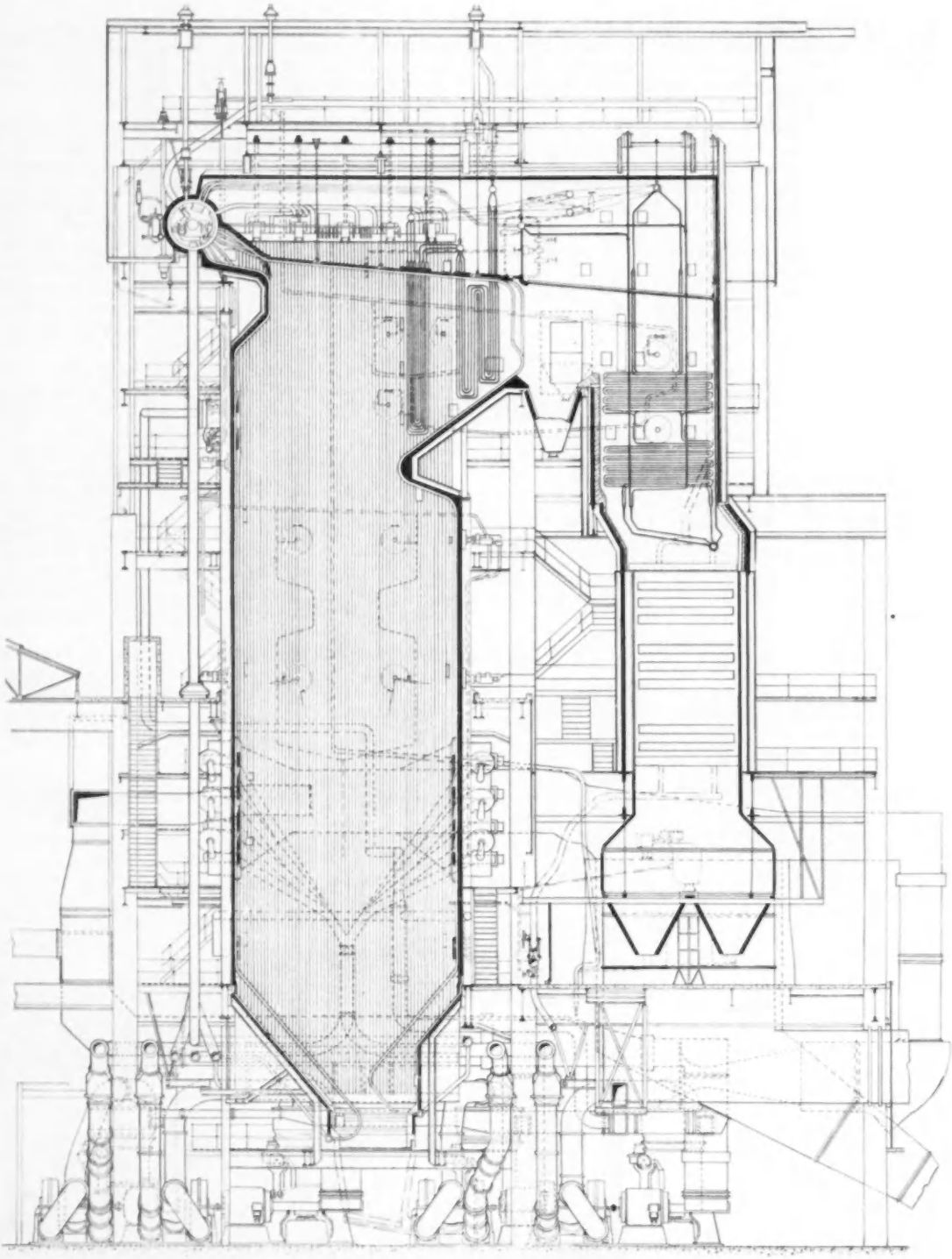


Cross-section of boiler drum showing arrangement of turbo-separators and other equipment for steam separation.

Feedwater, with an initial temperature of 410 deg. F., passes through the economiser, and enters the drum by a sleeved pipe at each end. The water-cooled furnace walls are supplied with this feed by downcomers to lower headers. The risers from the water-walls discharge into this same drum, the steam passing to the primary superheater section.

The arrangements for steam separation in the single drum are interesting, the initial separation of steam and water being facilitated by both centrifugal action, and by spreading out the water in a thin layer. This is accomplished by spinning the steam and water mixture in a number of vertical cylindrical pots called turbo-separators. The spin is imparted by fixed curved blades in the base, and the rotating water takes up a curved shape, the thin upper layer skimming over the top of the pot and returning to the drum. The steam passes through a primary scrubber on each pot, consisting of closely-packed corrugated plates; a method which involves a tight inner skin or baffle, behind which the steam and water mixture is collected.

The MeLeSco superheaters, supplied by The Superheater Co. Ltd. for each boiler, each have an effective heating surface of 32,180 sq. ft. The primary section consists of two horizontal self-draining stages, and the secondary section two pendant stages. Tubes taking the



CROSS SECTIONAL ARRANGEMENT OF ONE OF THE FOUR LOPULCO 830,000 LB./HR. SINGLE-DRUM RADIANT BOILERS WHICH WERE SUPPLIED BY INTERNATIONAL COMBUSTION LIMITED. THEY ARE CORNER-FIRED PULVERISED-FUEL UNITS OPERATING AT A PRESSURE OF 1,600 LB./SQ. IN. AND A STOP-VALVE TEMPERATURE OF 1,060 DEG. F.

capacity to service both the "A" and "B" stations.

The coal pulverising plant is of International Combustion Limited manufacture, and comprises four 16-ton/hr. capacity Lopulco-type LM 16/2 suction mills per boiler, each driven through reduction gearing by a 185-h.p. electric motor at 1,480 r.p.m. When firing East Midlands coal having a net c.v. of 9,700 B.Th.U./lb., and with a 14 per cent. ash content and a moisture content also of 14 per cent., three mills can supply the necessary coal at normal boiler rating, the fourth acting as standby. Each mill is air-swept by a DE 49/11 exhauster, and following standard Lopulco practice, each mill delivers a pulverised fuel/air mixture via the separator to one burner nozzle at each corner of the furnace, the nozzles being arranged to fire tangentially to an imaginary circle at the centre of the combustion chamber. The exhausters are driven by N-S variable-speed a.c. motors, rated at 305/82-h.p., and 1,470/960 r.p.m. Similar motors are provided for the mill feeders and separators, those for the former being rated at 2/0.28-h.p. and 2,200/314 r.p.m. and for the latter 10/3-h.p., and 2,200/880 r.p.m. These together with the actual mill motors were supplied by Laurence, Scott & Electromotors Limited.

An interesting feature of the pulverising plant at this station is the installation of a prototype Lopulco three-roll pressure mill on No. 4 boiler unit. This is a prototype of the design for the 550-MW unit boiler for Thorpe Marsh power station, which International Combustion Limited are to install for the Central Electricity Generating Board, and it is smaller than the ultimate production model. In co-operation with the C.E.G.B. this prototype mill has been installed at Willington, to provide test information over a trial period, in addition to operating data which will be of great value for the Thorpe Marsh contract. Preliminary details of this three-roll Lopulco design were published in the December, 1958, issue of *Engineering and Boiler House Review*.

Each boiler is equipped with 12 standard-type F.F.1/80 initiators; six placed in the front wall adjacent to the p.f. coal burners, and six in the rear wall. They were supplied by Fuel Firing Limited, and are used for raising pressure on the boilers from a cold condition to full working pressure, when burning 960 seconds oil of Redwood No. 1 viscosity. When pressure has been raised, the same initiators are used for ignition of the coal. Each initiator has its own integral fan so that the fuel/air ratios and velocities are at a fixed value to enable a very high degree of combustion efficiency to be attained so that there is no smoke emission, or carbon or oil deposits, anywhere in the boiler unit. The initiators are, of course, fully-automatic and remotely operated, and embody patented means of retraction of the burner from the furnace to afford complete protection from the effects of the pulverised coal flame when the initiators are not in use. Ignition of the initiator flame is achieved by a patented 12-V, high-heat release, igniter to give rapid and reliable establishment of the flame.

Boiler plant

The four boilers supplied by International Combustion Limited are, as previously mentioned, each designed for an m.c.r. of 830,000 lb./hr., at 1,600 lb./sq. in. and 1,060 deg. F. These units are of the Lopulco single-drum radiant design, with furnaces arranged for corner-firing through International-Combustion tilting-burners. They are of semi-outdoor construction, the building structure, from which the boilers and associated plant are supported, also serving as a partial roof.

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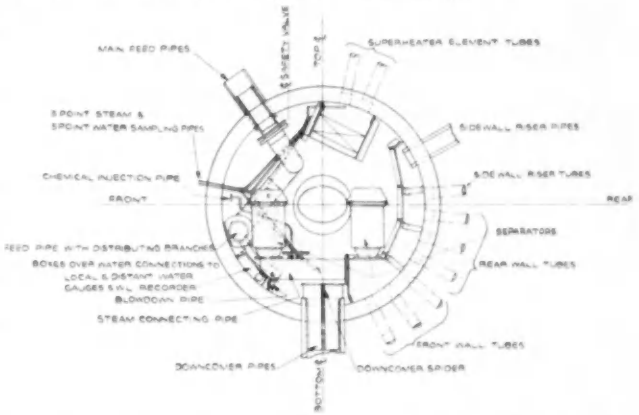

Cross-section of boiler drum showing arrangement of turbo-separators and other equipment for steam separation.

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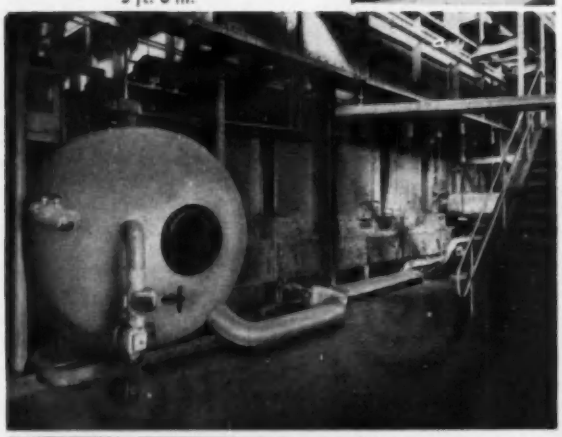
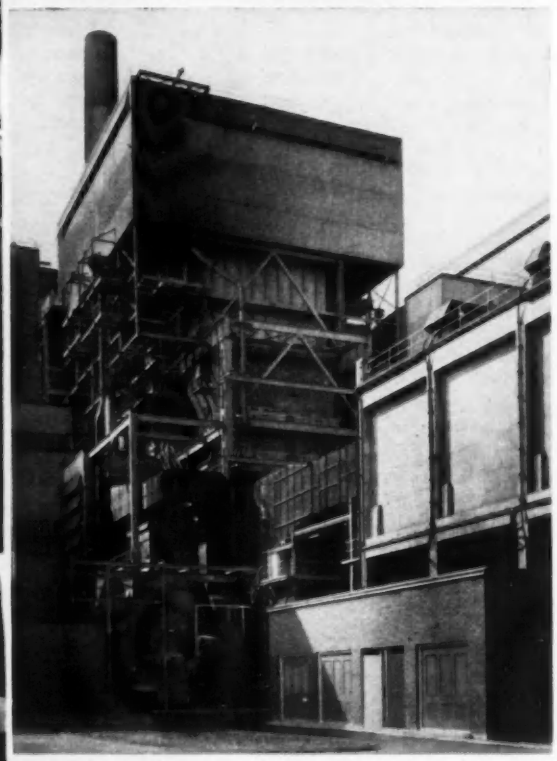
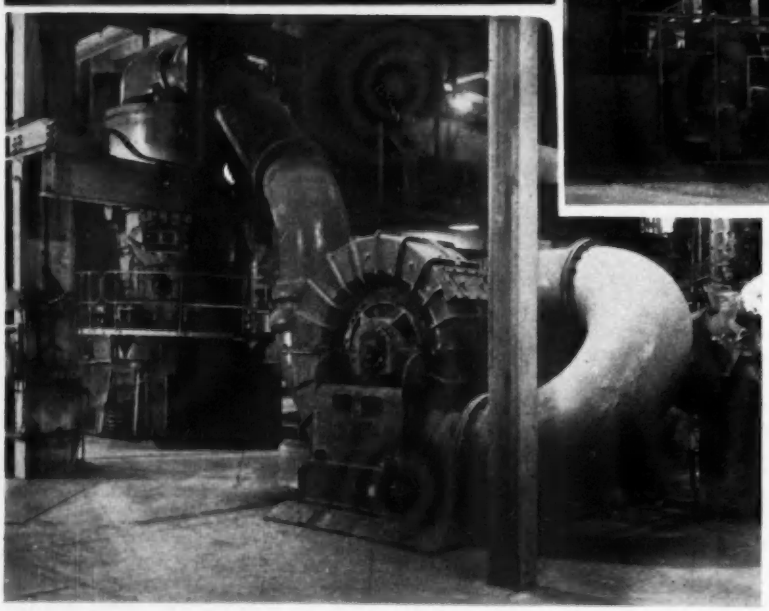
(Right). Coal conveyor and tripper over one of the boiler bunkers. There is one bunker per boiler, and its capacity is 1,400 tons.

(Below). View at drum level of one of the boilers. Each drum is 38 ft. 0 in. long, and has an internal diam. of 5 ft. 6 in.





(Above). One of the four International Combustion boiler units, which are only enclosed to the extent required for protection of operating staff, and of drum fittings and mountings against severe weather conditions.



(Left). There are four Lopulco-type LM16/2 suction mills per boiler, each mill being of 16 tons/hr. capacity.

saturated steam from the boiler drum to the primary superheater inlet header are arranged to form the roof and back wall of the rear boiler pass, and to provide steam-cooled supports for the primary superheater stages. The first stage secondary elements, which are nearest the furnace outlet, are of platen construction. MeLeSco "Acramet" thermocouples are fitted on inlet and outlet legs of selected secondary superheater elements, to provide a continuous record of tube metal temperatures at points within the gas-path. Steam temperature control is by means of the automatically-operated tilting-burners, with MeLeSco spray desuperheaters located in the cross-over pipe between the primary and secondary superheater sections as supplementary control.

The economisers for boilers No. 2, 3, and 4, were supplied by Senior Economisers Limited, and are of that company's welded cast-iron clad type, supported from steelwork immediately beneath the primary superheater. Each boiler unit is provided with two economisers in parallel, both arranged 24 tubes wide, and 32 high, the tubes being 14-ft. long over surfaces, making a total heating surface of 98,918 sq. ft. Gases enter the economisers at 1,145 deg. F., and leave at 567 deg. F., the feedwater temperature being raised from 410 deg. F. to 582 deg. F. For boiler No. 1, the economisers were supplied by E. Green & Son Ltd., and are of the Premier Diamond (type-8) of all-welded construction, and comprising 936 tubes, 26-ft. long, arranged in two banks side by side, having a total heating surface of 65,700-sq. ft. This arrangement is unusual in that the tubes are placed with their axes at right angles to the boiler drum, instead of the normal parallel arrangement. This has resulted in a compact layout, with central gas by-pass, fully damper controlled, and well distributed straight-through gas flow. Sootblowers have not been fitted to these economisers, but facilities are provided for occasional water-washing should abnormal circumstances occur, such as the need to remove deposit accumulations dislodged from the superheater and remaining on the economiser surface.

Duplicate Howden-Ljungström rotary regenerative air pre-heaters, type XZS.24, supplied by James Howden & Co. Ltd., are provided for each boiler. The individual units have a heating surface of 110,500-sq. ft., making a total for each boiler of 221,000-sq. ft. Flue gases passing through the heaters are reduced in temperature from 580 to 280 deg. F., while preheating the combustion air from 80 to 437 deg. F. at m.c.r. Each air-heater can be by-passed on the air side, and the units are fitted with sootblowers to clean the heating surfaces. Access for both inspection and washing of the heating surface is provided by sector doors, the bottom one being operated by a hydraulic cylinder interlock to prevent accidental opening.

The two f.d. and two i.d. fans provided for each boiler are of the "Sirocco" type supplied by Davidson & Co. Ltd. The former are 90-in. diam. single-inlet, backward bladed Aerofoil fans, with a capacity of 166,000 cu. ft./min., and driven by electric motors rated at 455/180 h.p. and 785/575 r.p.m. The i.d. fans are 108-in. diam. double-inlet, backward bladed Aerofoil units, with capacities of 234,000 cu. ft./min. and driven by electric motors rated at 860/57 h.p. and 790/316 r.p.m. All the motors were supplied by Laurence, Scott & Electromotors Limited, and are of the N-S variable speed a.c. design, with speed control by induction regulators; those for the i.d. fans being weather-proof machines of the closed-air-circuit type with air/air heat-exchangers.

Mechanical dust-collectors, also supplied by Davidson & Co. Ltd., and of the "Sirocco" cellular-type, remove the heavy grits from the flue gases before they pass to the electrostatic-precipitators. These latter were supplied by Simon-Carves Limited, and each comprises a twin-flow arrangement, each flow containing three electrical zones in series. Each pair of zones in parallel receives an independent electrical supply from h.t. rectifier equipments of the selenium-type incorporating automatic voltage-control and automatic reclosing devices, which ensure that the plant operates at optimum efficiency under all operating conditions. Each boiler unit precipitator was designed for an efficiency of 97 per cent. when dealing with 380,000 cu. ft./min. of gas leaving the mechanical collector at a temperature of 264 deg. F. and having a dust burden of 2.48 grams/cu. ft. at N.T.P. The plant, therefore, was designed to give a stack emission of 0.074 grain/cu. ft. at N.T.P.

Sootblowing equipment was supplied by Ivor Power Specialty Co. Ltd., and includes twenty 12-in. withdrawal valve-in-head electrically-operated gun-type sootblowers to clean the combustion chamber wall tubes, and the rear wall tubes. The superheater and reheater tubes are cleaned by 10 retractable lance-type sootblowers that have an approximate travel of 17-ft. 6-in. The air-heater soot-blowers are fitted with "Ivor" electrically-operated valves. The steam supply and drain valve controls were also designed by the Ivor Company. All the sootblowers can be operated either individually or in sequence, a fully-automatic control system having been installed by which it is possible for the operator to select the required valves and sootblowers.

Dewrance & Co. Ltd. were reponsible for the supply of all the boiler mountings and fittings, and for most of the pipeline valves.

The entire thermal insulation on the four boiler units, and the four air-preheater sets was carried out by The Darlington Insulation Co. Ltd. In the main this consisted of 85 per cent. magnesia preformed material in conjunction with Meta Dextramite preformed material. On external ducting, Darlington 85 per cent. magnesia preformed slabs were applied, weatherproofed with "Flintkote" emulsified asphalt.

Ash- and dust-handling plant

With four boilers operating continuously there is a daily make of 864 tons of ash and dust, and the ash and dust-handling plant, supplied by Babcock & Wilcox Limited, disposes of this in one 8-hr. shift every day. The clinker is collected in hoppers which are emptied each day into a high-velocity water sluiceway which conveys it to an ash-pit from which the water overflows into a dust-sump over C.I. weir plates; the water overflowing into the dust-sump being pumped to ponds. The plant is arranged so that, if desired, the weir plates can be replaced by screen plates so that all fines are carried through into the dust-sump for pumping to the ponds, only the larger ash being left in the ash-pit. From the ash-pit, the ash is loaded by means of a grabbing crane into drainage aprons and thence into road vehicles.

Dust is removed from the various collecting points by a plant of the Hydrovac system using feeder ejectors

and windswept valves, and Hydrovactors to discharge a mixture of water and dust into the dust-sump via high-velocity water sluiceways. Two pairs of dust-pumps working in tandem—one pair forming a standby set—remove the water and dust mixture from the dust-sump to the disposal area some four miles from the station. Water for the feeder ejectors, Hydrovactors and high-pressure jets in the sluiceways and ash-hoppers is provided by duplicate h.p. sluicing pumps of Mather & Platt Limited manufacture ; a connection from the h.p. header to the dust discharge lines being provided in order that the h.p. sluicing pumps can be used to purge the dust pipelines after dust pumping has been completed.

Control and instrumentation

The boiler and turbine instrumentation, automatic combustion control and feedwater control were provided by Electroflo Meters Co. Ltd. Each pair of units are operated from a single control room, which contains the unit operating desk, unit upright panel and unit cooling-water system control desk. Local boiler, turbine and feed control panels are, of course, also provided. The Electroflo-Smoot automatic boiler control maintains high combustion efficiency by controlling the rates of fuel and air flow in a predetermined ratio, with automatic correction for changes in fuel quality, by continuous comparison of steam evaporation with combustion air used. The desired steam pressure is maintained by controlling the fuel and air in accordance with steam load ; this is accomplished by means of a master controller which is connected to the steam system and which converts the changes in steam pressure that occur with load variation into an air-loading pressure for transmission to the individual regulators controlling the combustion rate.

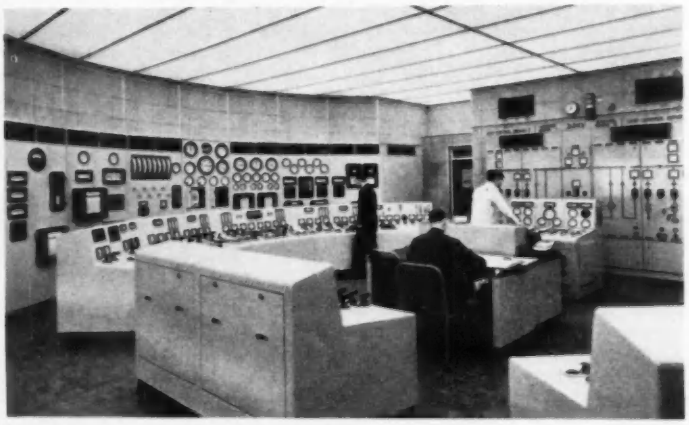
Speed drive on the fans and milling plant is by means of induction regulators, pilot motors being provided to control the induction regulators. The Electroflo regulators have been adapted by replacing the pilot valves with an electrical switch which initiates the operation of a three-pole reversing-contactor to energise the pilot motor and thus position the induction regulator. The mill feeder regulators control feeder speed in accordance with the master loading pressure. Simultaneously the primary-air regulators control exhauster fan speed so that the air flow differential, measured across an orifice-plate in the hot-air duct to the mill, exactly balances the master loading pressure.

Combustion air is controlled by the forced-draught air flow regulators which control f.d. fan speed so that the total air flow differential measured in the f.d. suction ducts exactly balances the master loading pressure. For abnormal conditions and changes in fuel quality, corrections are made to the air flow by the steam flow/air flow relay, which automatically maintains a definite ratio of steam evaporated to combustion air used. The furnace pressure is held constant by the induced-draught fan regulators. The two fans are operated in parallel by two positioners which are loaded from a sender relay in a measuring regulator. This regulator measures the combustion chamber pressure, and is independent of the master controller.

Auto/manual sub panels are provided to permit the operator to transfer the boiler from automatic steam pressure control to unified manual control at the panel or, alternatively, individual operation of the regulators. Push-button control of the pilot motors operating the induction regulators is also available on the panel in the event of control air failure.

Drum water-level is controlled by the Electroflo three-element system operating on either of two 100 per cent. Blakeborough feed control valves in parallel. The control valve is positioned by a hydraulically-operated regulator incorporating a special measuring element which compares feedwater-flow with steam-flow to maintain an exact balance unless modified by a further loading pressure indicative of the drum-level. The loading pressures representing feed-flow, steam-flow and drum-level are provided by Electroflo force-balance pneumatic transmitters.

Reavell & Co. Ltd. supplied two sets of three DSN7E carbon ring instrument air-compressors. These work at a pressure of 100 lb./sq. in., and each delivers 97 cu. ft./min. of free air, when running at 385 r.p.m. They are belt-driven from 27½-h.p. motors supplied by Lancashire Dynamo & Crypto Limited. Each machine is provided with an aftercooler separator, a Visco duplex pressure-filter, an air receiver and a Silica Gel dual absorber dryer to give dry and completely oil-free air for the operation of the instruments.



Each pair of 100-MW boiler/turbine unit sets are operated from a single control room. The boiler and turbine instrument equipment, automatic combustion control and feedwater control are provided by Electroflo Meters Co. Ltd.

Aiton & Co. Ltd. were responsible for both the high-pressure steam, and high-pressure feed pipework. The high-pressure steam pipework has been designed for superheater outlet conditions of 1,700 lb./sq. in. and 1,060 deg. F. Two 8-in. bore, 1.132-in. thick mains in F.C.B. (T) quality Staybrite stainless steel convey 830,000 lb./hr. of steam under full load conditions. All pipe joints are butt-welded and the mains are supported by " Uniload " constant-load supports of Aiton design, to accommodate the large thermal movements of the piping system. The high-pressure feed piping is

fabricated from carbon steel tubes 11¾-in. outside diam., 1.75-in. thick, for design conditions of 2,200 lb./sq. in. and 510 deg. F. All joints are butt-welded with the exception of the connections to the feedpumps, these being of the flanged-type incorporating a monel metal lens-type joint ring.

Thermal insulation of internal and external pipework and vessels was carried out by Versil Limited, the extent of this work including the main steam piping; h.p. and l.p. feed-piping; drain piping; blowdown piping; water piping; and receivers. Materials used consisted of Versil glass-fibre flexible sections and mattresses, finished on the internal work with armouring cement, canvas and finally paint, and on external work with aluminium sheeting.

Turbo-alternator plant

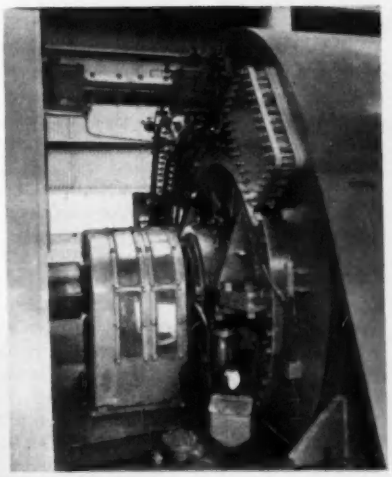
The four 100-MW turbo-alternator sets were supplied by The English Electric Co. Ltd., each being designed to operate with steam conditions of 1,500 lb./sq. in. and 1,050 deg. F. at the turbine stop-valve, and running at 3,000 r.p.m.

In conjunction with the turbine main governing gear, a Reavell & Co. Ltd. vacuum load-limiting device and vacuum trip are fitted which automatically reduces the load on the set by closing the governing valves when the absolute pressure in the condenser rises above a certain limit. The amount by which the governing valves are closed is determined by the rise in pressure until at a predetermined pressure in the condenser the governing valves are completely closed and the load is taken off the set. A still further rise in condenser pressure will operate a trip to close the emergency valve.

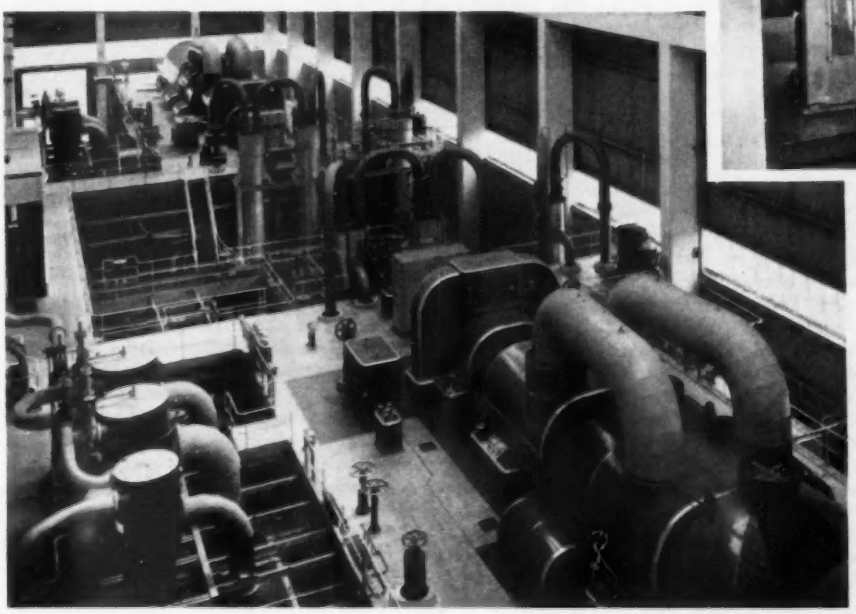
Each turbine exhausts into two English Electric two-pass condensers, having a total cooling surface of 76,700 sq. ft. and designed to maintain a vacuum of 28.9-in. Hg. The total cooling-water requirement is 64,000 gal./min. Condensate is withdrawn from the condenser by two 100 per cent. duty horizontal-spindle extraction pumps manufactured by Drysdale & Co. Ltd. Non-condensible residual vapours are removed by two of the three 50 per cent. duty rotary Leblanc-type air pumps supplied by Metropolitan-Vickers Electrical Co. Ltd. Quick-starting air exhausters of the rolling-drum rotary type, as manufactured by Reavell & Co. Ltd., are provided. These are designed to operate at 580 r.p.m., each having a displacement of 3,550 cu. ft./min. They are capable of providing a vacuum up to 20-in. Hg., taking 140-b.h.p. at the shaft, and are directly-coupled to motors manufactured by The English Electric Co. Ltd.

A six-stage feedwater heating system is designed to raise the temperature of the feedwater to 410 deg. F., when supplied with bled steam from the turbine at six points. The heating system comprises three l.p. and three h.p. heaters, the l.p. heaters being on the suction side of the booster feed pumps, and the h.p. interposed between these and the main boiler feed-pumps.

Three de-aerating plants are provided each of the twin-concentric-type, supplied by G. & J. Weir Limited, and each comprising two de-aerating vessels, and two de-vaporisers mounted on a storage-tank. Under non-evaporating conditions the de-aerating plant is capable of handling 601,250 pph. of feedwater at the inlet. The feed-



(Right). Special arrangements have been made for the direct hydrogen-cooling of No. 2 alternator. View shows special fan drive arrangement.



(Left). No. 1 turbine house showing two of The English Electric Co.'s 100-MW, 3,000 r.p.m. sets, which operate with a turbine stop-valve pressure of 1,500 lb./sq. in. and a temperature of 1,050 deg. F. The overall length of each machine is 98 ft. 4⅞ in.

water enters the de-aerator at a temperature of 207.5 deg. F. and leaves at an outlet temperature of 266 deg. F., i.e., a temperature rise of 58.5 deg. F. The quantity of heating steam required to give the above-mentioned rise in temperature is 30,360 pph. when supplied at a pressure of 40-lb./sq. in. at 284 deg. F. In addition, the de-aerator is supplied with 111,275 pph. of h.p. heater drains at a temperature of 334 deg. F.

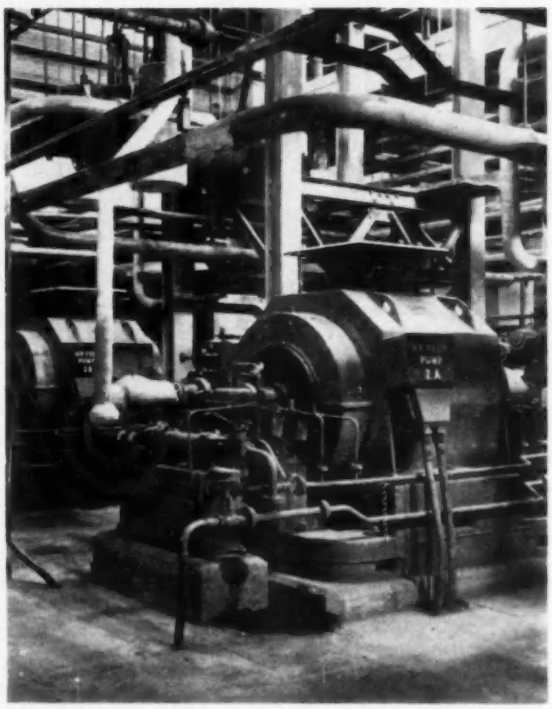
Under evaporating conditions, the de-aerating plant is capable of handling 628,500 pph. of feedwater at the inlet. The feedwater enters the de-aerator at a temperature of 207.3 deg. F. and leaves at an outlet temperature of 266 deg. F., i.e., a temperature rise of 58.7 deg. F. The quantity of heating steam required to give the above-mentioned rise in temperature is 31,650 pph. when supplied at a pressure of 39.25 lb./sq. in. at 282 deg. F. In addition, the de-aerator is supplied with 117,155 pph., h.p. drains at a temperature of 333 deg. F. Provision is made in the de-aerated water storage tank for a system of off-load de-aeration provided by English Electric Co. Ltd. Water can be drawn from the bottom of the tank by a circulating-pump which discharges through an electric water-heater back to the storage tank via three sets of spray-nozzles fitted along the top of the tank.

Each unit is provided with a double-effect bled-steam evaporating plant, designed to produce 25,000 lb./hr. of vapour, when the set is delivering its maximum output of 100-MW. Make-up water for the unit evaporators is obtained from the South Staffordshire Water Company's supply, and treated in plant supplied by the Neckar Water Softener Co. Ltd. Raw water is base-exchanged in a single manually-operated unit, the break-through of hardness being signalled from a Neckar automatic hardness detector. After softening, the water is dosed with sulphuric acid to liberate combined carbon-dioxide, aerated in a scrubber tower to remove the carbon-dioxide, and finally dosed with caustic soda to a desired pH value.

The difficulties arising from "hunting" of pH controllers, which is normally experienced with this system of water-treatment, have been entirely overcome by the incorporation of a control system, also supplied by Neckar to a specification of the consulting engineers, Ewbank & Partners Limited. The automatic system, applied for the first time in this country, controls pH values at the acid and alkali addition stages, at varying rates of flow, with a degree of precision which is claimed to be unique. The control equipment functions between 50 per cent. and 100 per cent. of the maximum continuous rating of 10,000 gal./hr. Pneumatic-controllers regulate the acid and alkali additions proportionately to the rate of flow. The dosing is made by plunger pumps provided with air-operated diaphragm motors, the positioners being actuated by air input signals from the control system. The pH controller/recorders are fitted with pneumatic transmitters which, operating in conjunction with averaging relays, act as trimmers to the proportional controllers which actuate the acid and alkali dosing equipment. A level-measuring element in the scrubber-tower sump incorporates a pneumatic transmitter which maintains a balance between incoming raw water and outgoing treated water.

All the main and booster feed pumps were supplied by Mather & Platt Limited. The booster pumps are four-chamber H.S. Plurovanes, delivering 1,610 gal./min. at 270 deg. F., against a 1,124-ft. head, and driven by squirrel-cage electric motors rated at 700-h.p. and 1,500/1,980 r.p.m. The main feed pumps are five-chamber H.S. Plurovanes, delivering 1,763 gal./min. at 410 deg. F., against a 3,910-ft. head, and driven by similar motors, but rated at 2,500 h.p., and 3,000/2,970 r.p.m.

Automatic intermittent chlorination plant, manufactured by Wallace & Tiernan Limited, is installed to prevent slime fouling of the condensers and to ensure maintenance of optimum heat transfer across the tubes, eliminating the necessity for periodic shut down for manual cleaning. The plant is designed to operate under automatic programme control, treating, intermittently and in turn, cooling-water passing to each condenser shell. The chlorination programme control panel permits the selection and setting of the frequency and duration of the chlorination treatment, and covers the application



The two main boiler feed pumps for each boiler/turbine unit are of 1,763 gal./min. rating, and were supplied by Mather & Platt Ltd.

of chlorine solution to the circulating-water inlet mains of each condenser shell as required. Control of plant operation and transfer of treatment from one application point to the next is carried out remotely from the control panel which includes indicator lights to show the sequence of operations. Two Wallace & Tiernan "Master" chlorinators have been provided, each with a maximum capacity of 6,000-lb. of chlorine per 24 hours, the treatment rate selected being designed to establish a concentration of chlorine of between 1 and 2 p.p.m. in the water passing through the condensers during treatment periods. Facilities are provided for plant operation under hand-switch control as an alternative to automatic control, and a reserve of chlorination capacity has been allowed to meet any emergency conditions which may arise.

For the provision of low-conductivity water used for evaporator stand-by and make-up purposes, a transportable mixed-bed "Deminrolit" plant, manufactured by Permutit Limited, was transferred from the nearby Castle Donington power station. This plant is self-contained, and has a capacity of nearly 4,000 gal./hr. It is mounted on a steel-framed raft to facilitate removal from one location to another and, in point of fact, disconnection at Castle Donington followed by removal to Willington and connecting up there ready for service occupied only 48-hours. The plant comprises a single mixed-bed unit—charged with an intimate mixture of cation and anion exchange resins—acid and caustic soda regenerating gear, pumps, compressors and other ancillary equipment. Water for the plant is drawn from the local mains supply and is demineralised during its passage through the mixed-bed unit; the resulting effluent being very low in content of dissolved solids, CO_2 and silica. This transportable mixed-bed "Deminrolit" plant is stated to have been so successful in operation that it is used as a source of supply of low conductivity water for many additional purposes within the station.

Main station control room is in a separate building to the north of No. 2 turbine house to which it is linked by a covered bridge.

Circulating-water is taken from the River Trent, and the system from the river to the station comprises a reinforced-concrete intake chamber on the North bank, with 72-in. diam. reinforced-concrete intake pipes discharging to a screen-chamber on the South side of the C.W. pumphouse. The four screens provided were supplied by J. Blakeborough & Sons and are of the revolving-drum-type, each with a capacity of 4,100,000 gal./hr. Drysdale & Co. Ltd. supplied the four C.W. pumps, which are centrifugal units of 4,100,000 gal./hr. capacity against a total head of 32.4-ft., each being driven by a squirrel-cage electric motor rated at 800-h.p. and running at 293 r.p.m. J. Blakeborough & Sons also supplied the necessary C.W. valves.

The two natural-draught, reinforced-concrete cooling-towers, constructed by Davenport Engineering Co. Ltd., are 300-ft. high, and associated with the towers are three pumps, all of Drysdale & Co. Ltd. manufacture, and each with a capacity of 3-million gal./hr. against a head of 73-ft. These units are driven by "Trislot," high-torque, low-current squirrel-cage induction motors rated at 1,350-h.p. at 420 r.p.m., and supplied by Laurence, Scott & Electromotors Limited.

Alternators

The alternators associated with the four turbines were also supplied by The English Electric Co. Ltd. Units Nos. 1, 3 and 4 are designed to provide the full output of 100-MW at 0.8 p.f. at 3,000 r.p.m., and generate at 13.8-kV. They are hydrogen-cooled, with coolers arranged longitudinally in the upper part of the stator frame. Ventilation is by means of axial-flow fans mounted on each end of the alternator rotor, and bearings are of the end-shield-type complete with seal oil equipment. The alternator for No. 2 unit differs from the remainder, and is of interest in that it has been arranged for direct hydrogen-cooling of the stator and rotor coils. Work on this project was undertaken by the company, with the full co-operation of the C.E.G.B., to develop the principle of direct conductor cooling on, by modern standards, a relatively small machine, and thus gain valuable manufacturing experience with this type of alternator prior to construction of the large alternators at present on order, and which require this type of cooling.

The equipment supplied for Willington "A" is basically designed to the C.E.G.B. standard for 120-MW reheat machines, although one-or-two minor modifications were necessary. These included modification to the "air gap" ($4\frac{1}{2}$-in. compared with the $2\frac{1}{4}$-in. of a conventional unit) to obtain the required short-circuit ratio of 0.8, and adjustment of the speed of the gas-blower, since the quantity of cooling gas required is much lower for the 100-MW rating. The speed of the blower was varied by adjustment of the gear ratio of the main gear-box which supplies the drive to the blower and exciters.

Opening ceremony

The ceremony was performed on Friday, October 2nd, by His Grace The Duke of Devonshire, M.C., who was welcomed by Mr. O. S. Woods, Controller, East Midlands Division, C.E.G.B. After the unveiling of a commemorative clock, and presentation of a memento to the Duke, and bouquets to Mrs. C. R. King, and Mrs. F. H. S. Brown, the response on behalf of the guests was made by Mr. E. B. Banks, Sales and Commercial Policy Director of the English Electric Company. Mr. Banks said that Willington "A," which was one of the two most advanced power generating stations in operation in this country, represented a notable land mark in the development and technique of power station design and construction. In making reference to the excellent co-operation which had existed between the plant manufacturers, the engineering consultants, and the C.E.G.B., he said that when ordered, some six or seven years ago, the alternators of the 100-MW. sets were to be of the conventional hydrogen-cooled type. The manufacturers considered that one unit should be designed to incorporate a newer type of cooling, to enable valuable test data to be obtained for this method which was subsequently to be used in the larger machines being manufactured.

Fibreglass Crown Fibre Production

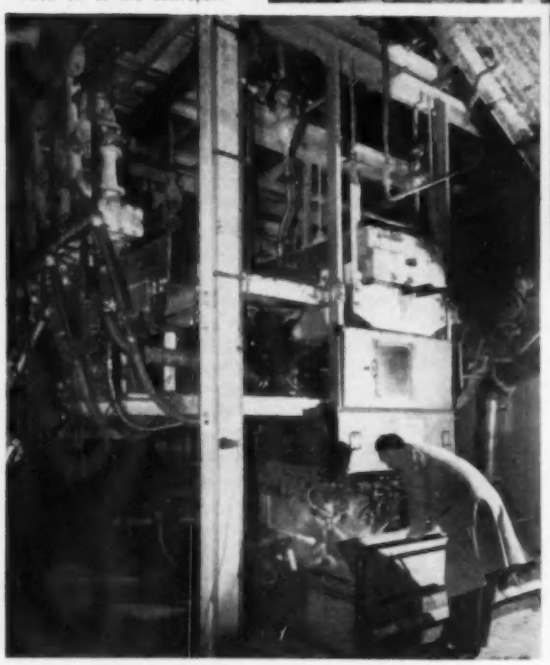
RECENTLY, we were invited to visit the St. Helens (Lancs) works of Fibreglass Limited, to see the manufacturing process of the firm's Crown range of insulation products. Early work on the industrial development of glass fibres was undertaken by a small department of Chance Brothers, at Glasgow, in the early thirties. From the handful of people then employed, to the present-day labour force of more than 2,000, the growth of this new industry will be appreciated. In the early days, output was limited to the manufacture of glass silk and simple products fabricated from this material. In 1938, a glass-wool manufacturing plant was installed, and the department gave place to a new company —Glass Fibres Limited, this name being changed to Fibreglass Limited in 1943.

In order to provide insulation material for prefabricated houses (it is claimed that more than 80 per cent. of them in this country were insulated with Fibreglass) the construction of the first glass wool plant was started at St. Helens in 1944. In 1948, a new factory for the production of continuous filament yarn was completed at Possilpark, Glasgow. Some of this yarn is produced at the St. Helens works, but only for development experiments.

The story of the Fibreglass company is one of continued plant expansion and of new products; and earlier this year an entirely new process known as Crown was introduced for the manufacture of certain wool products. In 1957, a new factory was established at Birkenhead and now the production operation is similar to that at St. Helens. The company produce the Crown range of products, resin-bonded materials, air-filter and tissue. At the Glasgow works, the plant is devoted to the production of continuous filament glass yarns, whilst at Birkenhead, glass-fibre mat products for plastics reinforcement, and superfine fibre for thermal and sound insulation requirements are made. The process is only in the initial stage—and new outlets for Fibreglass materials are continually appearing.

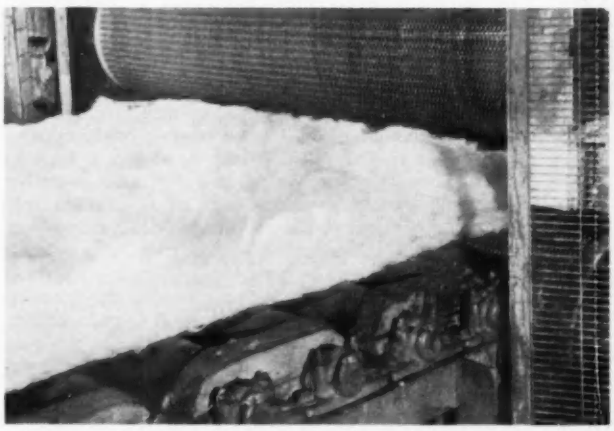
(Right). Uncured Fibreglass Crown fibres passing down from the collecting hood.

(Below). Crown fibres being sprayed with binder whilst passing through the collecting hood on to the conveyor.



During our visit to St. Helens we were able to see that the manufacturing operation of Crown starts by making molten glass at a temperature of about 1,100 deg. C., this being achieved by melting sand, limestone and other suitable constituents in an enclosed tank or furnace, by surface melting with town gas, sometimes boosted with oil. The resultant liquid glass runs along a canal (forehearth) and drops, or deposits, a stream of glass into a rapidly-revolving Ni-Cr alloy-steel dish, something like an inverted colander, with many hundreds of small holes around its periphery, and driven at 3,000 r.p.m.

By centrifugal force, the glass is thrown out through these fine holes to form a fibre and is subjected to further heating whilst in flight, to continue the attenuation process and to increase the fibre fineness. It is interesting to note that fibres so formed have a diameter of approximately 0.00024-in., which compares with 0.00060-in. for the old vacuum process. All these resultant fibres are directed downwards on to a travelling collecting conveyor, and on their way down are sprayed with a phenolic resin. This resin has the characteristic of producing a joining or welding of any two fibres at the point at which they cross, and the elasticity of the fibres makes it possible for this network to be compressed so that the air can be " squeezed out," but the mat will still recover to its original size, thus allowing the spaces containing the still air to resume their original function of insulation.



Fibreglass Crown fibres moving over rollers on their way to the curing oven.

The new " Crown " material consists of all long fine fibres. It contains no shot, no dust, no fall-out, and therefore ensures pleasant handleability. Previously, uniformly fine fibred, dust- and shot-free insulants have been available only at many times the price of Crown, which is cheaper than many of the Fibreglass products it replaces and dearer than none, and which, in all instances, offers economies both in storage and in application. Not only does the compression-packing reduce storage space but, of considerable importance today, reduces transport costs. Its great resilience and tear strength are claimed to permit speedy erection on exposed building sites, and this feature also affords advantages in numerous other insulation problems.

At a cost of approximately a quarter of a million pounds, Fibreglass Limited have installed, and are operating, one production line with an output at present of some 15-million cu. ft. of insulation per year, under the new Crown process. Eventually, all glass fibre insulation made by the company will be made by this process.

Apart from the lack of dust and shot, the manufacturers believe that the new material has several other points in its favour. The fineness of the fibre gives smaller pockets of air and, therefore, more efficient insulation so that the same effect is obtainable from less material—a useful saving in weight on a structure. The material is of better quality, handles better and has better recovery and strength. Recovery is important because it measures the ability of a highly flattened and compacted insulation to spring back to its original thickness. The recovery of the new product is up to 98 per cent., compared with typical figures of 85 per cent. for bitumen-bonded Fibreglass, rockwool and slagwool

At present, three grades of " Crown " are being made, viz., " 75," " 100 " and " 200," in densities of $\frac{3}{4}$ lb., 1 lb., and 2 lb./cu. ft. respectively. Crown 75 is in the form of a resilient and flexible bonded mat; Crown 100 is available in roll or slab form; whilst Crown 200 is in resilient semi-slab form. Crown 75 and 100 each have a thermal conductivity of 0.26, while the figure for Crown 200 is 0.23 per sq. ft. per hour per deg. F. per in., which compares with about 8.0 for brickwork, 1.0 for an air-space, 0.3 for slagwool, 0.20 for the best grade of Onazote expanded rubber, and is approximately 20 per cent. better than the old bitumen-bonded Fibreglass which has been in extensive use. Crown 75 is suitable for the insulation of roofs and walls of buildings; Crown 100 for marine applications, transport and domestic insulation requirements; and Crown 200 for thermal and/or sound insulation in marine, transport, and particularly refrigeration applications.

Within a year or so, Fibreglass Crown insulation is expected to be available in the form of rigid and flexible sections, strip, sawn sheet and wired mattresses, suitable for many industrial applications, including the insulation of boiler plant, pressure vessels, steam piping, ducting, etc.

NEW BOOK

" Steam Power Plants," *by C. D. Swift, Mechanical Engineer, Ebasco Services, Inc., 490 pages, 95 illustrations. Type area 4½ × 7½-in. Published by the McGraw-Hill Publishing Co. Ltd., 95, Farringdon Street, London, E.C.4. Price 89s.*

A sub-title to this book is " Starting, Testing and Operation," but the subject is taken even farther than this, as early chapters deal with design and purchase, construction, and plant personnel. Broad in scope, the book covers all classes of steam boilers and steam electric plant, and deals also with auxiliary plant, water-supply and treatment, instrumentation and control, and electrical systems. Throughout, general principles have been presented rather than a multitude of details applicable to individual items of equipment. Similarly, as regards those chapters on efficiency and water-testing, where test codes or standard water tests are available such data are not included.

UNIVERSITY SCHOLARSHIP SCHEME

Grammar and public schools throughout Great Britain have received details of 61 university scholarships being offered by the electricity supply industry. The scholarships are worth £450 a year for three years at Oxford and Cambridge, and £400 at other universities. Both boys and girls are eligible to apply. Scholars will be expected to read for degrees in science or engineering, to fulfil certain training requirements, and to return to the industry for two years after taking their degrees. The electricity supply industry is expanding rapidly due to the ever increasing demand for electricity, and modern technical advances, such as the development of nuclear power, make imperative the recruitment of highly qualified technical staff. The scholarships are intended to help the industry to meet its future requirements for such staff. Last year, when the scheme was launched, fourty-four awards were made, the holders of which are now beginning their university courses.

Progress in Stainless and Heat-Resisting Steels

By J. LOMAS

THERE has been an appreciable amount of activity in metallurgical progress during the past 12 months or so, and this has resulted in the production of a number of important and interesting new developments in the range of stainless and heat-resisting steels. In one short article it would not be practicable to summarise all these; a choice has, therefore, been made of those predominantly of interest to the engineer concerned with power plant materials.

To evaluate the influence of ambient conditions, a large number of studies have been made of racks of samples exposed to the gases in the superheater zone of oil-fired boilers. Steels with a high chromium content were found to have the most satisfactory degree of resistance, but were still subject to somewhat rapid deterioration in this severe environment, where the presence of sulphur, vanadium and sodium tends to accelerate severe corrosion.

A precipitation-hardenable alloy has been introduced, and is now being commercially developed. It contains 26 per cent. nickel, 13 per cent. chromium, 1.5 per cent. molybdenum, 2.8 per cent. titanium, 0.03 per cent. boron, the balance being iron. The boron content is said to greatly improve ductility, so that the titanium content, designed to give greater strength, can be increased from about 2.0 per cent. to 3.5 per cent. Consequently, the resultant material is considerably stronger, and has a longer creep-rupture life under a specific stress.

A thorough investigation has been carried out to determine whether it is possible to improve the high-temperature strength of 80-20 nickel chromium alloys by the addition of refractory powders. It appears that the liquid-phase sintering techniques have produced the most successful results. Stress rupture tests at 982 deg. C. showed a stress of 2.75 tons/sq. in. for an 80-20 nickel chromium alloy containing 1 per cent. titanium oxide and a carbonaceous material. Reports show that the liquid-phase sintered material gave twice the strength of the non-oxide-containing alloy. Room temperature strengths of the metal/oxide composites were consistently of the order of 22.5 tons/sq. in. The thermal shock properties were adequate, and the oxidation resistance good, although not quite so high as that of the wrought alloy.

Austenitic nickel chromium steels of the niobium (columbium) and titanium stabilised types have, for a long period, been used with success as materials for superheaters, but it has been doubted whether it would be possible to use the unstabilised qualities, despite their economic and structural advantages. It was feared that prolonged heating at the temperatures involved might cause intergranular corrosion or stress corrosion cracking. Actual tests carried out have shown that the unstabilised steels suffer no more attack than the stabilised, in synthetic condensates. All the steels were susceptible to cracking. An unstabilised 18/8 stainless-steel was installed in the pendant superheater of a boiler, and revealed no intergranular corrosion after a 54 month period of service.

In recent years, it has frequently been reported that a particular stainless-steel, extensively used for steam-piping in power generating stations, and piping adopted for various purposes in nuclear power plants, is difficult to weld. This steel contains 0.08 maximum carbon, 17-19 per cent. chromium, 9-12 per cent. nickel, and columbium 10 × C. min. per cent. Many attempts have been made to overcome this difficulty, and some time ago a new welding electrode was developed containing 16 per cent. chromium, 8 per cent. nickel, 2 per cent. molybdenum. This seemed to give better results, and was, therefore, fully investigated over a lengthy period. It is now established that the new electrode is generally satisfactory, although some cracking has been found to occur in the finished weld. It seems that in welding a stabilised stainless-steel containing columbium, cracking cannot be completely overcome with the new electrode, but certainly this electrode has made a considerable contribution to the solution of the welding problem with this particular material.

Cast stainless-steel valves, tees, and other fittings made from an extra-low-carbon 18-8 stainless-steel have been used in the primary loop of a pressurised-water reactor designed to operate at 2,500 lb./sq. in. and 670 deg. F. This is the first time that "cast" fittings have been used for the primary loop, which handles water actually heated by nuclear heat. The fittings are cast in sizes up to 30-in. and include 45 and 90 deg. elbows, tees and reducers, while valve bodies range up to 30-in. All the castings are subjected to dye-penetrant and X-ray tests, and to a hydrostatic test at room temperature, and to 6,000 lb./sq. in. pressure. They are said to give yield and tensile strengths as much as one-third higher than required; elongation and reduction of area about half as much again; and impact values three times as high.

The principal means by which efficiency and lower unit cost in power generation can be gained is by the use of higher steam temperatures and pressures. Hence, the use of stainless-steels and the higher alloyed materials is increasing. Important parts needed to handle pressurised-water or liquid sodium are often more economically designed as high-alloy castings, especially when the shapes are too intricate for manufacture as forgings or welded assemblies.

Two new precipitation-hardenable materials have been developed—the first by vacuum melting, the second by electric melting. One contains 0.05 per cent. carbon, 15 per cent. chromium, 15 per cent. nickel, 4 per cent. molybdenum, 4 per cent. tungsten, 3.0 per cent. titanium, and 1 per cent. aluminium. The other has 0.25 per cent. carbon, 18 per cent. manganese, 12.5 per cent. chromium, 3.0 per cent. molybdenum and 0.2 per cent. nickel.

The heat- and corrosion-resisting alloys and steels are, as stated, innately hard to form by ordinary processes. In the production of annular components, however, increasing use is being made of the advantages afforded by centre spinning, which enables the foundryman to produce castings for power plant requirements that are free from physical imperfections, and have satisfactory mechanical properties, oxidation- and corrosion-resistance, and weldability. The process has been applied to only a couple of nickel-base age-hardenable alloys.

There is a tendency, however, for hot shortness—a form of brittleness produced by conditions of high temperature—to be experienced by cast chromium nickel austenitic stainless-steels. This tendency is being overcome by the addition to the melt of 0.05 to 0.025 per cent. vanadium and 0.01 to 0.15 per cent. titanium. Boron, in amounts up to 0.002 per cent., has also been found beneficial.

Boron in somewhat larger quantities has been used as an element in hard surfacing materials comprising a powder mixture of a hard alloy, and a material relatively soft, e.g., stainless-steel; the hard alloy consists essentially of nickel, chromium and boron. The composition of the hard alloy is nickel 65 to 85 per cent., chromium 8 to 18 per cent., boron 2 to 4.5 per cent., iron 1.25 to 5.5 per cent., silicon 1.25 to 5.5 per cent., cobalt up to 1.5 per cent. and carbon 0.3 to 1 per cent. The powder mixture is sprayed on to the surface of the parent metal, and coatings so produced are said to be porous and oil-retentive, machinable and resistant to corrosion; they also show good resistance to abrasion and wear.

The service life of carbon-steel condenser tubes is governed to some extent by the degree of contamination of the cooling water. Where the water is contaminated by acid drainage, it is not possible for protective scale to be desposited and so prevent the corrosion of steels, as in fresh water. Carbon-steel condenser tubes used in a wash-oil regenerating system failed after about four months' service as a result of corrosion; but 18-8 chromium-nickel stainless-steel tubes tested under the same conditions, and for the same period of time, were virtually unaffected. As a result, this particular condenser is to be equipped entirely with tubes of this material.

Steam generated by heat from boiling water nuclear reactors does not greatly differ from that produced in conventional power stations, but it possibly contains a higher moisture content, it may be radioactive, and embodies free hydrogen and oxygen. While it was not believed that radioactivity in or of the steam would affect steels to any extent, little was known of the erosive effects of wet steam under high-pressure conditions, and of the effect of oxygen on the corrosion of metals in high-temperature water/steam mixtures. Investigations have been extensive, and it is now suggested that in wet steam, stainless-steels are among the most resistant of the metals liable to erosion. Stainless-steel also resists the increased corrosion rate of materials subjected to an increase in the oxygen level from "low" to "high" at temperatures of 300 to 430 deg. C. Intergranular corrosion and pitting caused by high oxygen concentrations were most satisfactorily withstood by the stainless-steels.

Two more new stainless-steels have been introduced in the U.S.A. One contains about 0.1 per cent. carbon, 0.2 per cent. silicon, 0.75 per cent. manganese, 16.5 per cent. chromium, 4.25 per cent. nickel, 2.75 per cent. molybdenum and 0.1 per cent. nitrogen. The other has the same basic composition, but the carbon is increased to 0.15 per cent., and the chromium correspondingly reduced to 15.5 per cent. Both steels are austenitic, and as formable and weldable as other austenitic stainless-steels. They have, however, a different microstructure, and consequently different mechanical properties.

The adherent chromium oxide film on stainless-steels provides them with their high-resistance to corrosion, but it makes their surface treatment more difficult. Nitriding is an example, so that it cannot be used to give these steels a hard outer surface. A new salt bath treatment has, nevertheless, been introduced which is claimed to destroy the oxide film on an 18-8 chromium nickel stainless-steel in approximately one quarter of an hour, so that the steel can then be effectively case-hardened. Nitrided austenitic stainless-steels are said to have improved fatigue resistance, and to maintain hardness and oxidation resistance up to approximately 540 deg. C.

Abrasion resistance of stainless-steel

Service tests have been carried out to determine whether stainless-steels, for example, could advantageously replace low carbon steel for plant handling coal, coke and ash, and other abrasive materials. Such steel had to prove itself not only technically suitable, but also economic, in that its service life relative to that of low-carbon-steel should more than offset the higher cost. It was found that stainless-steel was both economical and technically efficient for skips and the dead plates for coke screens. The stainless-steel sheet should, however, it is suggested, be reinforced by welding on stainless-steel strips to prevent flexing, which increases wear.

A stainless-steel which is buoyant in water has been developed in the United States.

When 13 per cent. chromium steels, after rapid cooling, are tempered at 500 to 600 deg. C., the corrosion rate increases, probably because of the proportion of chromium carbides. With tempering at above 700 deg. C. it has been found to decrease, probably because of uniform distribution of chromium. This arises out of a series of studies on the subject of corrosion at power generation stations in Japan, in which river-water with a high acid content was used. Welded parts are usually much corroded, but this can be prevented, it is claimed, by tempering at above 700 deg. C., after welding. With the addition of 1 per cent. titanium to the steel, newly-welded parts are not subject to rapid corrosion.

Extrusion of stainless steels is offering great advantages to the designer. Among these are freedom of section design; reduction or elimination of machining operations; production of integral forms in place of joining two or more parts; economical production of small quantities where demand does not justify rolling; production of non-rollable shapes; economies over forged or cast parts; better mechanical properties where transverse loading is encountered, and so forth. Stepped, tapered and multiple extrusions are all possible, and show the potentialities of the extrusion process.

A heat-exchanger (steam generator) is being constructed with a shell made from chromium nickel stainless-steel, and tubing of a different composition of the same material. It is designed to withstand the corrosive effect of water under a pressure of 2,000 lb./sq. in. at over 500 deg. F.

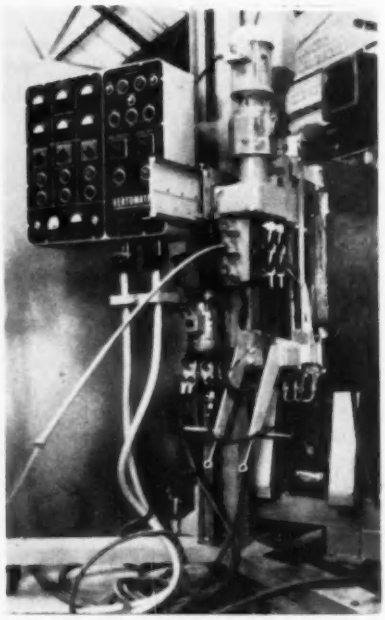
Welding Equipment Demonstration

RECENTLY we were invited to attend a demonstration of welding equipment just introduced by Rockweld Limited, in its factory at Grafton Road, Croydon, Surrey. The equipment specially demonstrated included the "Vertomatic" automatic vertical slag-welding machine, shown in the accompanying illustration. Rockweld Limited acquired a licence for the manufacture of this machine from Vus (Bratislava), and it is particularly intended for welding heavy plates of from 1⅛-in. to 14-in. thickness. The welding head of the machine is mounted on a carriage which has a vertical traverse up a column to enable plates of up to 13-ft. wide, or more, to be welded together.

The plates to be butt-welded are set vertically in front of the machine carriage, with a gap of 1⅛-in. to 1¼-in. between the edges. From the carriage, the electrode wire or wires (depending upon the thickness of the plates) are fed downwards through curved wire guides into the gap between the plates. Molten weld metal and slag are retained in the gap by water-cooled copper shoes, which ride on the faces of the plates and move upwards as welding proceeds. A feature of the Rockweld-Vus machine is that the traverse of these shoes is controlled entirely automatically in relation to the level of the solidifying weld metal. The wire guides oscillate in the gap; this oscillation is important in securing the highly satisfactory weld metal properties obtained. Granulated flux is dropped into the cavity, and an initiating arc established with the electrode wire in a manner similar to the submerged-arc process.

Arc energy, however, is used only initially to fuse the flux into molten slag which then, owing to its temperature, becomes a highly ionised mass offering a path of relatively low resistance to current flowing from the electrode wire to the pool of weld metal and the adjacent plate edges. Electrical energy expended in the slag and weld metal in this way maintains the continuous fusion of the electrode wire. To obtain consistent energy dissipation with thick plates, a transverse motion, backward and forwards, can be automatically imparted to the electrode wire as it is fed into the slag.

During the welding operation, contact between the shoes and the parent plates is maintained by pressure exerted from flexibly-mounted arms. The automatic movement of the welding nozzle and shoes and the automatic supply and flux are controlled by a set of relays operated by contacts attached to one of the shoes. This method of control maintains a consistent head of molten slag above the pool of weld metal. As the pool of weld metal builds up, the lower part is continuously cooling to form a homogeneous weld with effective penetration of the parent plates and with smooth, clean, external faces contoured by the copper shoes. Penetration is controlled by the width of gap between the parent plates and by voltage applied across the weld. The control equipment provides for the adjustment of the voltage which can be pre-set or varied during welding. The transverse movement of the wire feed nozzle is also adjustable, and its correct setting plays an important part in ensuring consistent mechanical properties. Uses of the "Vertomatic" electro-slag welding process are not confined to butt welding of flat plates. It is also, for instance, applicable to circumferential welds on heavy cylindrical work.



"Vertomatic" automatic vertical slag-welding machine for plates from 1¼ in. to 14 in. thick.

Also demonstrated, was the Rockweld "Comet" semi-automatic welding process in which the arc is struck between a special composite continuous wire and the work piece, in an atmosphere of carbon-dioxide gas. The wire contains the deoxidising agents and the slag-forming materials, whilst the carbon-dioxide protects the metal from atmospheric contamination during transfer, and in the weld pool. It is thus a visible-arc process, and is readily adaptable for both automatic and semi-automatic operation. The equipment incorporates the Rockweld Company's "Autopak" transformer and welding head. The head is mounted on a carriage together with a wire spool, coupled through a flexible feed tube, to a gun. Carbon-dioxide is fed from normal cylinders to the gun via a pressure regulator and flow-meter, and is introduced round the arc area through an annular copper nozzle on the gun.

With the "Autopak" head, the wire feed is controlled automatically as with submerged-arc welding, to give a pre-selected constant arc voltage. The "Comet" process will, it is claimed, find its major application in the semi-automatic welding of down hand butts and horizontal-vertical fillets, but it has the advantage that it can also be used for horizontal-vertical butts as, for instance, occur in the welding of oil storage tanks.

New Scottish Engineering Works

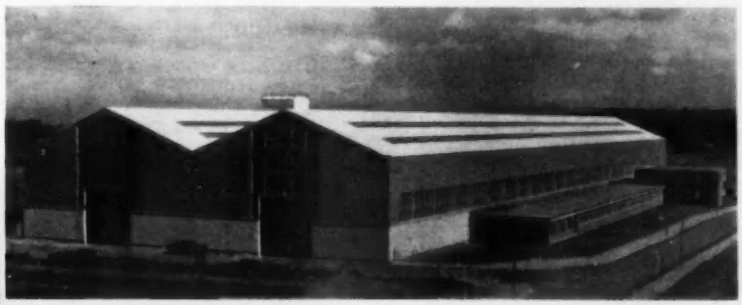
THE firm of J. H. Carruthers & Co. Ltd. was first established at Polmadie, Glasgow, in 1887, to undertake the manufacture of marine pumps, separators, filters and condensers. During the Second World War, a new division was established for the production of overhead cranes, this latter work being carried out at works in Lambhill and Parkhead. Recently, the whole of the manufacturing facilities of the company were brought together, when a new factory was opened at East Kilbride, Glasgow.

Carruthers claim to be one of the first organisations in the world to introduce the duplex steam pump. This was as long ago as 1887: and only 10 years later this development was followed by the introduction of their first compound duplex pump. A centrifugal-type pump, driven by one of their high-speed steam engines, was shown by Carruthers at the 1901 Glasgow Exhibition. This pump was the first centrifugal design unit of a range which today includes the well-known "Flowmaster" self-priming pump.

Among other equipment available from the pump division of the company, the "Suprex" oily-water separator and the "Vortex" pipe-line and boiler separators are all developments of an original centrifugal separator introduced in 1887. Referring to the crane division, since 1955 the main effort has been devoted to welded box construction—Carruthers being among the first to adopt this method of fabrication, and also the welded-tube crane girders.

The new factory comprises two main bays. These are portal-framed structures, each designed to carry 25-ton overhead travelling cranes having a span of 70-ft. The upper walling on the north, east and south walls is Robertson "Q" panelling, with Turner's combined asbestos sheeting on the roof and the west wall, where the structure and walling is designed for future extension. The lower part of the wall for 11-ft. up from the floor level consists of an 11-in. cavity brick wall. The complete factory has been designed to comply in every respect with the latest legislation for thermal insulation; in the cases of the "Q" panelling and the asbestos sheeting this insulation is obtained by means of a fibre glass in-fill. A generous allowance has been made for natural lighting by means of roof and side wall windows. The pump bay is so designed that units of up to 25-tons in weight may be handled with simplicity. The standard range of pumps is adequately served by the machine shop in this part of the works; however, there is also a large horizontal boring machine in the crane works which can be used for the machining of) t ; i ze equipment. A test bed is also available, and has been designed to handle pumps having outputs of up to 2,000-tons of water/hr. Steam is produced by an electrode boiler operating in conjunction with a steam accumulator. Full steam pressure can be obtained within five minutes of switching on the boiler, and the steam output can be controlled by suitable setting of the boiler controls. Power, both a.c. and d.c., is also available on the test bed for motor-driven pumps, the d.c. supply being produced by a motor generator set. The water-measuring equipment has been carefully designed to ensure that maximum accuracy in the readings is obtained, and in every case British Standard recommendations have been used. Loads of up to 50-tons may be handled with ease in the crane works, the layout of the flame-cutting stations and fabricating beds being such as to promote the swift flow of production. The gear-box covers are bolted to the monobloc gear-box and crab, and machined as a complete entity on a large horizontal boring machine, thereby ensuring the greatest possible accuracy of positioning of bearings, etc.

The factory area is heated by hot-water pumped through radiant panels, the head in the system being maintained at 50-lb./sq. in. by a nitrogen pressure generating unit, while the office-heating operates on a low-pressure pumped system, fed via a calorifier from the factory system. Hot water for both systems is obtained from three electrode boilers which have a combined capacity of 7,400,000 B.Th.U./hr.



(Above). The two main bays of the new works of J. H. Carruthers & Co. Ltd. at Polmadie, Glasgow.

(Left). Interior of main machine shop in which the standard range of Carruthers pumps is dealt with.

Power distribution in the factory is principally by means of a bus-bar system on each outer wall and between bays. In addition to this, small under-floor ducts have been incorporated below the machines to facilitate movement and reconnection should this become necessary. A liquid oxygen plant has been installed and this, together with a bulk propane supply, ensures that gas is always available in the fabrication shop, and also eliminates completely the handling of cylinders inside and outside the shop.

The General Electric Co. Ltd. states that, following discussions which have taken place during the last few weeks between The General Electric Co. Ltd./Simon-Carves Limited, Atomic Energy Group, and Atomic Power Constructions Limited, an agreement has been reached to collaborate in the design and construction of nuclear power stations in the United Kingdom. The two groups have agreed to submit joint tenders for Dungeness and further stations in the British nuclear programme. This development does not affect the two groups' existing contracts and commitments, either in the United Kingdom or overseas. The Central Electricity Generating Board and the South of Scotland Electricity Board have been informed. Negotiations are continuing with a view to long-term collaboration on future reactor systems.

RECENT Equipment AND Accessories

Automatic oil burner control

Newman Industries Limited announce that they have begun production of an automatic oil-burner control—the first of a new range of electronic control instruments. These units are applicable to many entirely different industrial applications, yet they are standardised and interchangeable with many of the components having a common use. There is, for example, one standard plug-in sub-chassis for all the units. This policy of rigid standardisation greatly

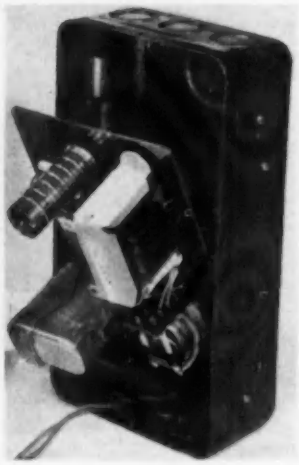


Fig. 1. The new automatic oil-burner control. (Newman Industries Limited.)

reduces the number of component spares a manufacturer must hold. The new (type 7540) automatic oil burner control is constructed in a standard plug-in sub-unit to facilitate installation and maintenance. Where applications demand 100 per cent. reliability, replacement sub-units can be stocked and rapidly interchanged to maintain continuity. This control relies on a photo-electric detector for flame detection, and a thermal relay to control the failure-to-ignite time. As the requirements of different manufacturers' burners and grades of fuel oil recommended are not identical, the F.T.I. time can be set during installation. The circuit has no thermionic valves, which ensures the exceptional reliability of the instruments, while a warm-up period is dispensed with. The control is suitable for smaller installations where non-recycling control is adequate [this facility, including pre-ignition purging and ignition overlap, is incorporated in a more comprehensive control (type 7542) now in the development stage]. The starting sequence is initiated by closing a time or thermostat switch as required. Emergency flame failure is arranged to lock out the burner which then requires resetting before normal operation can be resumed. (*Newman Industries Limited, Yate, Bristol.*)

New d.c. amplifier

Fielden Electronics Limited have recently made available a new d.c. amplifier having a stability of 0.1 per cent. This amplifier should become a most useful component in all systems where a d.c. output of several milliamperes directly proportional to a d.c. input of a few millivolts is required with a high degree of repeatability. Typical applications are in strain gauge systems for weight measurements, in computers, and in temperature control systems where a saturable core reactor is used. The amplifier can be supplied in chassis form or in a weather-proof sheet steel case and has plug-in ranging units which cover standard ranges between 2 mA output for 5 mV input and 15 mA output for 65 mV input; instruments requiring an input of only 2 mV for 2 mA output are available to special order. It is potentiometric in operation, and responds to a change as small as 1 microvolt at the input; no measureable change in the output occurs when a resistor in series with the input is varied between zero and 50 ohms or even higher. The output load resistance can be as high as 3,500 ohms. The completely transistorised electronic circuits operate at radio frequency, and the overall performance is determined largely by a highly stable resistor in a feedback circuit; thus errors due to unstable power supplied or to a "chopper" are avoided. Only two transistors are employed. The instrument consumes only a few milliamperes from a 12 volt d.c. battery or power supply unit, and supply variations as great as ± 15 per cent. cause an error of only ± 0.05 per cent. in the output. The transistors generate no heat so that long term stability without attention over several years is achieved. Should it ever be necessary to service the "electronics" this is quickly achieved by means of a replacement plug-in electronic unit. (*Fielden Electronics Limited, Wythenshawe, Manchester.*)

Electronic time delay unit

In their electric motor control gear intended for industrial or other timing applications, Brook Motors Limited now incorporate an electronic time delay unit of their own design. It is suitable for use with start to run motor switching on manually-operated starters; slip-ring auto-

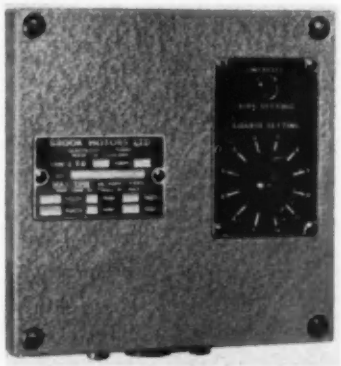


Fig. 2. New electronic time delay unit in sheet metal box housing. (Brook Motors Limited.)

matic starters; motor braking periods; sequence starting and stopping; and process control timing and cycling. A notable feature of the unit is the infinitely variable time delay setting. This is obtained by using a "coarse" control switch in conjunction with a variable rotary sliding resistance to give fine adjustment. For example, on a model-3A timer operating on 415-volts, which has a maximum time delay of 2 min., there is a "coarse" switch with 12 positions. The first position has almost zero seconds delay, the second position has 10 sec. delay, the third 20 sec. delay, etc. The "fine setting" control is used for times falling between the values rising at 10 sec. intervals on the "coarse setting." The unit is available without its sheet metal box housing for mounting in a manufacturer's own enclosure, in which case the overall dimensions are 5½-in. × 5½-in. × 2 4/5-in. In the standard housing the dimensions are 6¼-in. × 6¼-in. × 3¼-in.

Non-standard features available include:—(1) Timer for use on other voltages, between 100 and 650 a.c. or 200 and 650 d.c. (2) Special control switching to one of the following arrangements:—(a) two normally open or (b) two normally closed sets of contacts; (c) one normally open and one normally closed contact. (3) Timers with heavy duty (3 amp a.c., 1.5 amp d.c.). (*Brook Motors Limited, Empress Works, Huddersfield.*)

High-efficiency dust collection

Mancuna Engineering Limited announce the introduction of a new development of the miniature cyclone—the D.584 Mancuna-Dustex Collector—which has been fully-tested

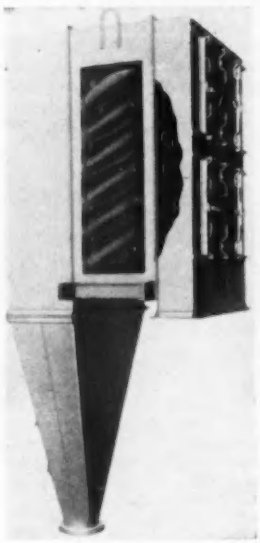
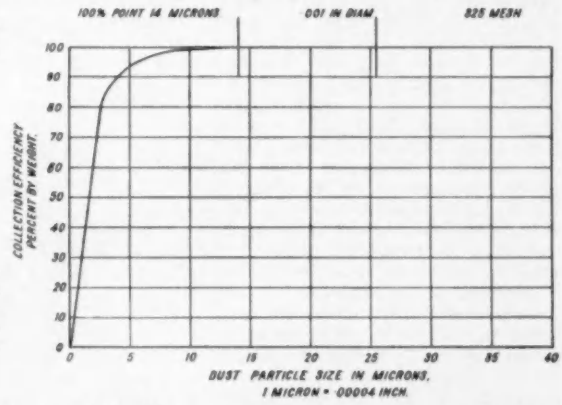


Fig. 3 (left). The new miniature cyclone—the D.584 Mancuna - Dustex collector. (Mancuna Engineering Limited.)

and applied in a number of both medium- and large-scale plants in the U.S.A. during the last two years. The D.584 provides for the same very high order of efficiency as the earlier D.450, and yet permits a higher gas volume per cyclone tube with a reduced pressure resistance, hence achieving considerable economies in capital and operating costs. The collector comprises a number of standard cyclone tubes whose unique design, coupled with the employment of the most advanced foundry techniques, combine to produce a cyclone tube and scroll inlet in one single casting. The tubes are cast with a $\frac{1}{16}$-in. wall thickness, and are available in stainless steel, aluminium alloy, or in an unannealed malleable white iron with a very hard working surface and exceptional resistance to abrasion. It is claimed that no other multi-cellular dust-collector can produce a comparative recovery efficiency on fine particle dusts—the accompanying efficiency curve indicates performance results. In addition, cyclone tubes are located in the clean-air stream which maintains the tubes at system temperature and prevents condensation and any subsequent tendency to build-up and blocking. A quality engineering product, space-saving, abrasion resistant and maintenance - free, the D.584 high-efficiency miniature cyclone collector is expected to extend considerably the range of application for high-efficiency mechanical dust-collectors. (*Mancuna Engineering Limited, Denton, Manchester.*)

Fig. 4 (right). Efficiency curve of Mancuna miniature cyclone.



Rotary electric vibrator

A new design of rotary electric vibrator has been introduced by Sinex Engineering Co. Ltd. for use as a power unit in such equipment as feeders, conveyors, screens, knock-out beams and grids for foundries, compacting tables, shutter vibrators and in the discharge of material from storage hoppers. The many disadvantages of this kind of machine, such as short bearing life, overheating and cracked housings, have, the company claim, been eliminated, and exhaustive tests have, they say, shown that amplitude and centrifugal force need not be sacrificed to ensure longer life of bearings and windings. Manufactured in four sizes, the machine is dust-proof and simple to install. It can be provided with automatic timers for intermittent operation, and can also be fitted with flameproof connections. Oil or grease lubrication is employed, depending upon the intended duty. The unit is particularly compact, and consists essentially of a squirrel-cage motor carrying out-of-balance weights at both ends of the rotor shaft. The four sizes provide centrifugal forces of 300, 500, 1,960 and 7,600-lb. respectively, these figures relating to running at the standard synchronous speed of 3,000 r.p.m. Vibrators running at 1,500 r.p.m. (for handling or compacting certain difficult materials) or providing larger centrifugal effects can be built to special order. Special windings other than the standard 440-V, 3-phase can also be provided. (*Sinex Engineering Co. Ltd., North Feltham Trading Estate, Feltham, Middlesex.*)

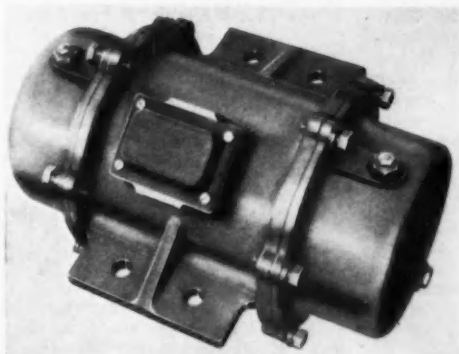


Fig. 5 (left). Sinex rotary electric vibrator. (Sinex Engineering Co. Ltd.)

Fig. 6 (right). New Baldwin speed regulator for compressed - air cylinders. (Baldwin Instrument Co. Ltd.)

Speed regulator for compressed air cylinders

A new speed regulator, for use with their compressed air cylinders, is available from Baldwin Instrument Co. Ltd. These new units are an improved development of the earlier micrometer type, and have a regulation of at least three times that of the previous model. The bore sizes are ¼-in., ½-in., ¾-in. and 1-in. The new regulator is slightly larger, and utilises the same two-piece construction as its predecessor. The unit is made from Duralumin, which is anodised. An important feature is a friction device incorporated in the body of the regulator which prevents the micrometer adjustment from being disturbed by vibration. Where the speed of movement of an air cylinder is required to be different in each direction of movement, the new speed regulator is a simple means of producing this. The regulator screws directly into the exhaust ports of the directional control valve, and thereby throttles the escape of air from the exhaust end of the cylinder. Where steadiness of motion is required, this method of speed regulation is to be preferred. All the regulators are screwed B.S.P. (parallel series), to conform with nominal bore size, and it is recommended that they should be sealed to the valve body by the use of soft metal washer or bonded seal. The maximum working pressure is 150 lb./sq. in. (*Baldwin Instrument Co. Ltd., Brooklands Works, Dartford, Kent.*)

New 8-in universal elevator

The Hodgkinson Group of Companies announce that Bennis Combustion Limited are now manufacturing a new 8-in. universal elevator for boilerhouse applications. It is of the familiar chain and bucket type, designed to handle the usual boilerhouse fuels at rates up to 1½-tons/hr., but here all similarity to conventional elevators ends. Standardisation is the keyword, and this has resulted in many advantages which, the makers claim, are not possessed by other types of elevators, not the least being low installation and maintenance costs. Any length of elevator, for any inclination of between 60° and vertical, can be built up from a series of standard components and the design is so simple that an elevator can be bolted together and lifted into position in a matter of hours. There are five basic units—the feeding mechanism, the boot, lower section, mid-section and the head which incorporates the drive. The standard mid-sections are approximately 8-ft. in length but smaller sizes are available so that any particular length of elevator can be built up. Also, a special curved mid-section can be supplied where site conditions make a vertical elevator necessary. A completely new type of feeding mechanism is incorporated, which cannot be jammed by extraneous matter since there is neither ram nor paddle, simply a flat oscillating plate. The body is hinge-mounted at the base and head so a high degree of accuracy at the

Fig. 7. The new Bennis 8-in. universal elevator for boiler house applications. (Bennis Combustion Limited.)

floor of the pit is not necessary and small site adjustments to the slope of the elevator can be made easily during erection. (*Bennis Combustion Limited, Little Hulton, Bolton, Lancs.*)

Flame-proof "Gilbarco" electronic gauge

A new model of the "Gilbarco" electronic tank gauge for use on deep storage tanks is shortly to be made available. The new model, CMB-107U, is housed in a ductile iron case, as opposed to the standard aluminium case, and retains all the features of the previous model, including accuracy in the field to $\frac{1}{16}$-in. and in the laboratory to 1/64-in. The gauge reads the true level of the liquid in feet, inches and sixteenths, regardless of its specific gravity. It is power-actuated to overcome the effect of varying friction in pulley sheaves, and the variation in the weight of the measuring element at high and low liquid levels. It can be adapted to almost any type of remote transmission, and provides the basic accurate data necessary for a co-ordinated system of remote transmission. The gauge can be equipped for automatic selection of temperature averaging resistance thermometers, and can be fitted with high- and low-level alarms. All metals and other materials used in the gauge are selected to resist corrosion. It can be installed, serviced, re-calibrated and maintained without taking the tank out of service. The gauge may be installed to measure water level or the interface of two products. In multiple storage tank installations, the gauge on each tank can be connected to a Firth Cleveland "Gilbarco" null-balance receiver for remote liquid level and average temperature readings. The standard receiver is equipped to read these data from 30 tanks. Since no current flows through the instruments when readings are being taken, errors caused by transmitter loading are eliminated. The receiver incorporates a means of remotely

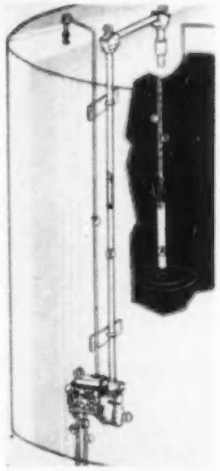


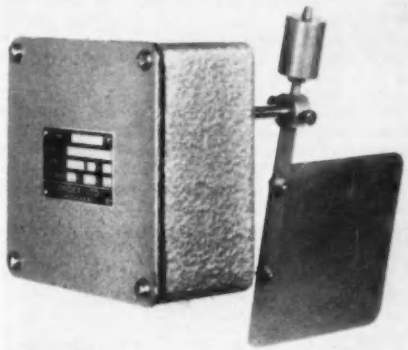
Fig. 8 (right). Gilbarco electronic tank gauge (Firth Cleveland Instruments Limited.)

checking and proving the accurate operation of each gauge from the instrument house. An air purged version of this receiver can be supplied for mounting in hazardous areas. (*Firth Cleveland Instruments Limited, Stornoway House, Cleveland Row, St. James's, London, S.W.1.*)

Mechanical shaft seal seat for high-temperatures

The reasons for the premature failure of mechanical shaft seals due to temperature conditions exceeding those for which the seal components were designed, although the actual temperature at which the liquid being handled was lower than the limit imposed by these components. have been investigated by Crane Packing Limited. Following extensive tests, it was established that failure was due to the severe

increase in temperature above that of the liquid being handled, which occurs between the seal faces and which is transmitted to the body of the seal. For example, contact face temperatures of seals handling water at 230 deg. F. and 25 lb./sq. in. were found to rise by from 390 deg. F. to 750 deg. F. above the temperature of the water. Tests made with various rates of coolant circulation around the seal face produced very little improvement, and temperature conditions of this order still prevailed. After a series of attempts to devise a means of dissipating the heat generated in the body of the seal, Crane Packing Limited finally succeeded in arranging for this process to take place by introducing new designs of standard seats, the principle being that their surfaces are extended, thus providing a greater area through which heat can be transmitted to the coolant liquid. The introduction of these new types of standard seat has made possible the use of simple seals and seal arrangements on liquids at much higher temperatures than was previously possible; the only limiting factor being that of the temperature limits of the other components of the seal, such as synthetic rubber in the case of the lower priced seals, which has a limit at 250 deg. F. (120 deg. C.), and Fluon in the more expensive seal units, which has a limiting temperature of approximately 450 deg. F. (230 deg. C.). Details of Crane Packing Limited mechanical shaft seals are contained in a new Information Bulletin (No. 18) available from the company. (*Crane Packing Limited, Slough, Bucks.*)



Londex type-AS air-flow switch (Londex Ltd.)

Air-flow switches

Londex Limited have developed a range of switches which are actuated by air flow and designed for use in all applications where the control of an electrical circuit is required, dependent on the "flow" or "no flow" of a gas. A typical switch is the type-AFS, suitable for applications where the velocity of air flow is 275-ft./min. or higher. The unit is housed in a strong welded steel case, with a back inspection-plate. The vane assembly, which comprises the air vane and counterbalance, is fitted to a stainless-steel shaft. The shaft is supported internally by two ball races and carries a mercury-switch of special design which does not affect the dynamic balance. The weight of the air vane is compensated by the counterbalance, an arrangement which allows the vane assembly to be positioned on site to suit the direction of air-flow without altering the sensitivity of the unit. In addition, an internal adjustment is provided enabling the sensitivity to be varied. Switching capacity is normally 1-amp at 250-V a.c. If multiple contacts are required, a relay can be included in the casing. A flameproof switch, type AFS/FP, is available. Here the vane shaft is coupled magnetically to a snap-action switching mechanism, thus avoiding the need to make an entry into the flameproof casing for the shaft. (*Londex Limited, Anerley Works, 207, Anerley Road, London, S.E.20.*)

Hollow plastic fans

Marston Excelsior Limited, a subsidiary company of Imperial Chemical Industries Limited, have acquired from the Hudson Engineering Corporation of Houston, Texas, the sole right to manufacture Hudson hollow plastic industrial fans in the United Kingdom. The fans will be sold under the trade name "Marex." Initially, the standard range will consist of four-bladed fans ranging from 6 to 14-ft. dia. in increments of 2-ft. in dia. A set of hollow plastic blades may be fitted to two types of hub, either the auto-variable hub, which by means of a pneumatically-activated diaphragm alters the angle of pitch while the fan is in motion, or the adjustable pitch hub, which requires that the fan be stopped while a simple manual alteration of pitch is carried out. On both hubs the angle of pitch may be varied between − 15° and + 30°. It is claimed that the advantages of these fans over conventional wooden and metal types lie in the materials, method of construction and the aerofoil shape. Blades are made of woven glass cloth and pigmented epoxy resin, laminated as a one-piece moulding. These materials form a self-coloured blade, which is corrosion- and heat-resistant, while the method of construction gives blades of smooth surface, high strength, and low weight. The makers claim that they will not shatter or fragment and, being hollow, are extremely light; a set of blades for a 10-ft. dia. fan weighs 58-lb. Following extensive wind-tunnel tests, the blade contour, a true aerofoil section, has been determined to give optimum performance characteristics. Fan blades of the same size are readily interchangeable as all blades are balanced at the works to a standard value. Installations in America and in other countries are, it is stated, giving entirely satisfactory service moving hot dry air through heat-exchangers in desert areas, moving hot moist air from water-cooling towers, moving corrosive laden air from chemical process vats, and in large volume ventilation systems.

* * *

Nickel-chromium casting alloy

Henry Wiggin and Co. Ltd. announce that Nimocast 713C nickel-chromium casting alloy has been added to the range of Nimocast Alloys and is now available in the U.K. Nimocast 713C is the Wiggin-made equivalent of Inconel 713C, an investment casting alloy for high-temperature service developed in the research laboratories of The International Nickel Company Inc. Nimocast 713C is one of a number of complex high-nickel casting alloys developed in recent years for high-temperature turbine blading. It combines outstanding strength with excellent resistance to thermal fatigue at temperatures up to 980 deg. C., and is, therefore, of interest as a possible alternative to wrought alloys, which offer difficult production problems when developed for service at such elevated temperatures. Nimocast 713C is readily castable and develops its best properties when cast in vacuum. Alternatively, it can be cast under a protective atmosphere such as argon. A heat treatment of two hours at 1,170 deg. C. followed by air cooling is beneficial but not essential unless the maximum mechanical properties are required.

* * *

Combustion Chemicals Limited, Elcot House, 33, Dorset Square, London, N.W.1, announce the introduction of their range of Premium fuel oils, which are regular grade residual fuel oils that have been pre-treated with Desulfurol fuel improver and sulphur inibitor. These new Desulfurol-treated fuel-oils are now available to all residual fuel-oil users in London and the Home Counties, and the service will shortly be extended to cover the whole country. CCL Premium fuel oils will sell at the same standard schedule prices as apply to existing regular grade residual fuel oils, with the appropriate discounts for quantity. The oils are supplied in the three popular grades—200, 950 and 3,500 sec. Redwood No. 1. As the oils have been pre-treated with Desulfurol fuel improver and sulphur inhibitor, they are claimed to be sludge free, and give better atomisation due to the reduced surface tension—the spreading property is stated to be 2½ to 3 times that of the equivalent untreated fuel-oil. Desulfurol treatment has been proved over many years by users on the Continent, and more recently by users in this country. With this treatment, the harm-

ful effects of sulphur inherent in regular fuel oils are suppressed, which therefore restricts sulphate scale, sulphur corrosion and fouling, acidic smut emission, sulphur contamination and noxious sulphur fumes.

* * *

Boiler plant for Spain

The accompanying illustration shows a 60-ton steam drum leaving John Thompson works, at Wolverhampton, for the new 60-W power station, at Mata, Barcelona, Spain. The drum has a length of 42-ft. and a dia. of 6-ft. John Thompson Water Tube Boilers Company are manufacturing and erecting the complete steam-raising plant for this power station, the main contractors for which are The British Thomson Houston Export Company. Total value of the contract is £2¼-million, of which the John Thompson share is in the region of £1-million. Obtained in the face of very heavy foreign competition, the contract carries a penalty clause for failure to complete within 22 months. Oil-fired, the Mata steam-generator will have an m.c.r. output of 550,000 lb./hr. at a working pressure of 950-lb./sq. in., and the final steam temperature will be 915 deg. F. Heating surface of the boiler will be 7,850-sq. ft., and that of the associated economiser and air-heater, 27,100-sq. ft. and 64,600-sq. ft., respectively. The water-treatment plant and the feed-dosing equipment is being supplied by John Thompson-Kennicott Company, Wolverhampton.

A four-day conference was held by **George Kent Limited,** at Luton, at the end of September. From the introductory to the closing session, both of which were under the chairmanship of Commander P. W. Kent, R.N., there was an extensive programme of discussions projected for the free expression and examination of views on all matters, both technical and marketing. These discussions were preceded by a review of company policy; also dealt with were future plans in relation to the company's whole range of industrial instruments, meters and automatic controllers in the home and export markets. Attending the conference were members of the Kent world-wide sales organisation from Canada, Australia, South Africa, Malaya, Thailand, Belgium, Germany, Austria, Spain, Eire, France, Czechoslovakia, Holland, Sweden, Norway, Italy and South America, in addition to U.K. area representatives. The conference was also attended by members of the board of directors of the parent company, together with senior research development, production, service and sales engineers.

* * *

Mr. L. R. Mortimer has been appointed as representative of Kelvin & Hughes (Industrial) Ltd., in the South Eastern Counties, in succession to **Mr. A. R. Mewitt,** who has now been appointed to the position of assistant technical sales manager.

Planned by the Heating and Welding Department of the **A.E.I. Transformer Division,** a series of exhibitions and demonstrations of Metrovick welding equipment have been arranged in various centres of industry. Their purpose is to provide an opportunity for all users and potential users of welding to see the latest types of equipment in operation. The first exhibition was held in Newcastle upon Tyne during the first three days of September, on the premises of the Rutherford College of Technology, and the attendance emphasised the effectiveness of local demonstration. It was repeated in Birmingham (October 19th-30th), in the Midlands Electricity Board showrooms, Aston. Equipment exhibited included both resistance-welding and arc-welding sets. The resistance-welding section comprised air-operated spot welders, projection welders and butt welders. Among the arc-welding equipment, an automatic arc-welding machine, suitable for either open or submerged arc-welding, was demonstrated using the submerged arc process. Single- and multiple-operator a.c. welding sets, rectifier arc-welding sets and inert-gas arc-welding equipment were also shown. Associated equipment included a rope parting machine and a rivet-heating machine. Using the a.c. "Thermac" welding set and the d.c. rectifier unit, test runs were made, using various Metrovick electrodes to give a practical demonstration of their qualities.

William Boby & Co. Ltd., water treatment engineers, Rickmansworth, Herts., are supplying two complete demineralisation plants for Mexican power stations, One is for installation at a new power station in Oaxaca, being built by Associated Electrical Export Limited, for the Comision Federal de Electricidad Juchitan. Boby's are also supplying acid-dosing plant for the condenser cooling-water. The second and similar set of equipment is for another of the Comision's stations, as yet unnamed.

* * *

Dr. J. N. Aldington, managing director, Siemens Edison Swan Limited, and a director of Associated Electrical Industries Limited, left this country by sea, en route for Canada, on September 24th. This is one of a series of personal visits which he is making to Siemens Edison Swan Overseas Group operations, and follows similar visits to South Africa, Australia and New Zealand during the last 12 months. It is anticipated that these visits will be repeated periodically over the next few years, to enable personal touch to be kept with overseas agents and customers. Dr. Aldington spent a few days in New York at the beginning of his tour and will do so again at the end of the tour, in order to make business calls on customers and company contacts. He is due back in this country on November 2nd.

* * *

The contract for the construction of the superstructure to the southern half of Belvedere Power Station, near Erith, Kent, has been awarded by the Central Electricity Generating Board, Southern Project Group, to **M. J. Gleeson (Contractors) Ltd.,** North Cheam, Surrey. The contract, valued at approximately £400,000, is to be carried out by Gleesons in addition to their construction of the £1¼ million superstructure to the northern half, which is already in operation. The entire 480-MW station is due for completion by June, 1961, the architects for the scheme being Farmer and Dark, F/F.R.I.B.A., London.

* * *

The following have been elected directors of B.H.D. Engineers Limited:—**Mr. P. Rushworth,** director and secretary, and **Mr. A. J. M. Henshaw,** director and general sales manager, W. C. Holmes & Co. Ltd., and **Mr. P. Croset,** managing director, The Holset Engineering Co. Ltd. B.H.D. Engineers Limited comprises the following companies: W. C. Holmes & Co. Ltd., Huddersfield; The Bryan Donkin Co. Ltd., Chesterfield; George Waller & Son Ltd., Stroud; British Furnaces Limited, Chesterfield; B. Thornton Limited, Huddersfield; The Holset Engineering Co. Ltd., Huddersfield; Holdan Engineers (London) Limited, London.

* * *

Lancashire Dynamo Nevelin Limited have issued the following new lists—LS.1250 and LS.2700. The former gives the general specification, ratings and prices of Nevelin fused distribution boards, while the latter deals with the firm's motor control gear of the automatic direct-on-line and star-delta types.

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

100-MW power plant for German colliery

As will be seen from the accompanying diagram (Fig. 1) the plant installed at the Graf Bismarck Colliery in Gelsenkirchen is equipped with two Steinmueller boilers. The m.c.r. rating of these boilers is 160 tons/hr. (353,000 lb./hr.) at a pressure of 210 atm. g., 3,980 lb./sq. in. and 525 deg. C. (977 deg. F.) final steam temperature. The boilers are of the forced-flow once-through Benson type, and are equipped for reheating partially expanded steam at 50 atm. g. (710 lb./sq. in.) to 525 deg. C. (977 deg. F.). From the economiser, the feedwater is admitted to 19 tubes arranged in parallel, no intermediate headers being provided in the tube system. As the boilers are fed at supercritical pressure, evaporation takes place at approximately critical pressure in the furnace tubes. The upper part of the secondary combustion chamber contains the radiant live steam superheater and the reheater. Two spray-type desuperheaters are provided in the live steam circuit. The temperature at the reheater outlet is controlled by a gas by-pass damper control, final temperature adjustment being made by means of a spray-type desuperheater. The boilers are fired with a mixture of sludge and pulverised fuel of 4,300 kcal/kg. (7,740 B.Th.U./lb.) lower heating value, with 15 per cent. moisture and 28 per cent. ash. The spray-type desuperheaters are supplied with feed-water from the feedwater supply. The high-pressure differential prevailing between steam and feedwater in some of the desuperheaters makes it essential to use highly wear resistant injection valves of the type shown in Fig. 2. It is reported that this design has proved very satisfactory in service. During starting, steam is expanded in the vertical vessel shown in Fig. 3. This is of 5.8 m. (19 ft. 4 in.) length and 1 m. (3 ft. 4 in.) dia. Expansion takes place in the upper part of the vessel. Four traps of the cascade nozzle-type are used to discharge the water from the vessel. They are controlled pneumatically by actuators connected to the lower part of the expansion vessel at various levels. (*E. U. Hesse, BWK*, August, 1959, pp. 362-369.)

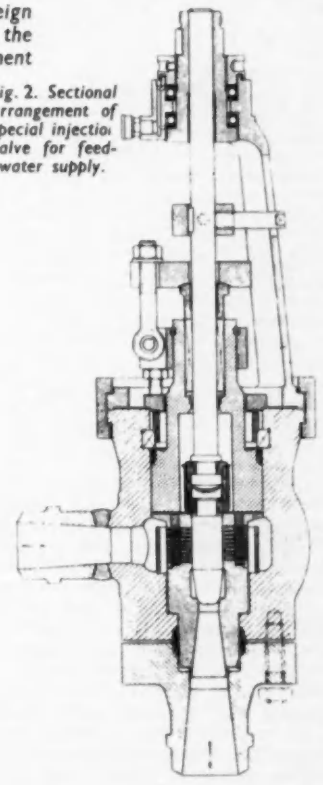


Fig. 2. Sectional arrangement of special injection valve for feed-water supply.

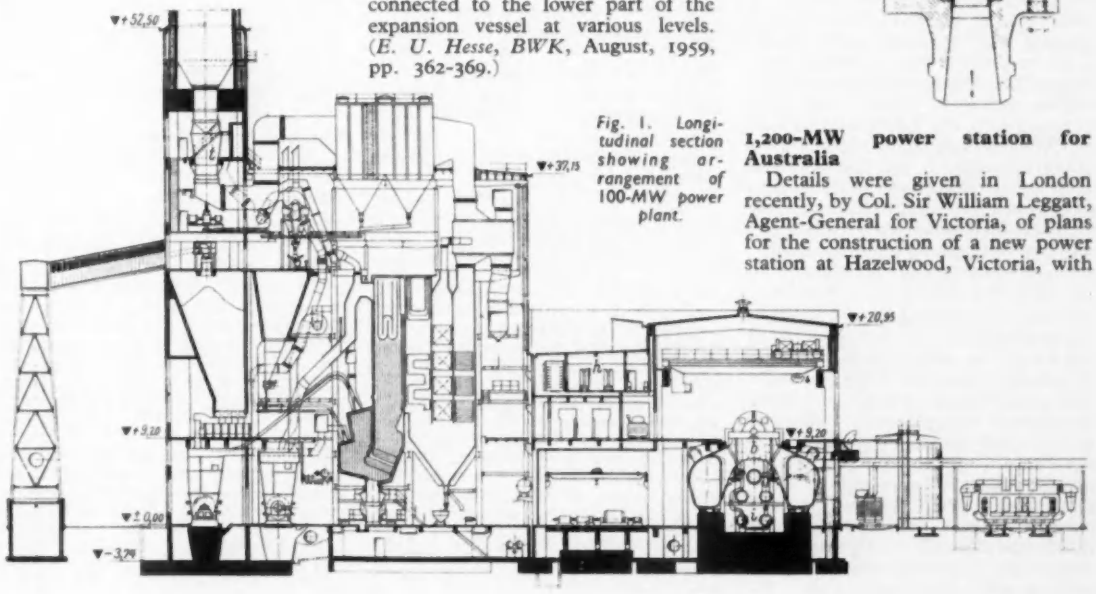


Fig. 1. Longitudinal section showing arrangement of 100-MW power plant.

1,200-MW power station for Australia

Details were given in London recently, by Col. Sir William Leggatt, Agent-General for Victoria, of plans for the construction of a new power station at Hazelwood, Victoria, with

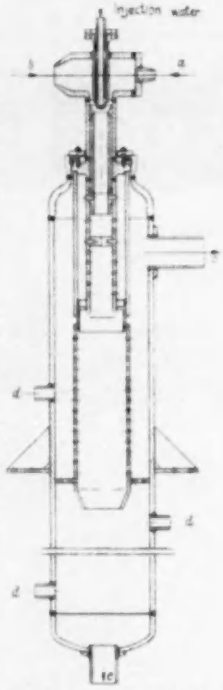


Fig. 3. Outline arrangement of expansion vessel for German colliery 100-MW power plant.

Key:—(a) Connection from starting steam line. (b) Connection from safety valve. (c) Outlet connection. (d) Water drain connection. (e) Connection to condensate drain.

an ultimate capacity of 1,200-MW—three times the size of any existing generating plant in Australia. Sir William said that Parliamentary authority was being sought for the project, which it is estimated will cost between £A122-million and £A128-million. The boilers associated with the new station would be designed to burn brown coal, which would be delivered by belt-conveyor direct to the site from open-cast mines in the Latrobe Valley. Sir William went on to say that 70 per cent. of Australia's recent industrial development had taken place in Victoria, and this immense proliferation of industry could not possibly be financed from their own resources. There were altogether 200 major British or British associated factories in Victoria, and more were going up rapidly. American investments in Victoria were, however, catching up with British.

Continuous coal feed by weight

Feeding coal to p.f.- and cyclone-fired units by weight makes possible (1) closer control of air/fuel ratio; (2) equal division of fuel flow among the several firing units of a single boiler; and (3) direct regulation of the rate of coal feed by combustion-control-system impulses. A new gravimetric feeder has been designed for this purpose, and combines the usual functions of a coal scale and feeder in a single unit that feeds coal continuously and accurately, by weight. It is designed to discharge exactly 100-lb. of coal for each turn of the head shaft. Headshaft speed is thus equivalent to rate of coal feed and can be expressed as lb./min. or lb/hr. of coal, as desired. Instruments can be provided to indicate coal feed rate and total coal burned. Each feeder is driven by a variable-speed motor. Control for this motor balances the speed of its output shaft against an electrical voltage furnished by the combustion control. This assures a coal-feed rate that corresponds exactly to combustion requirements. As indicated in the accompanying illustration (Fig. 4) a short length of the special feeder belt is supported on two fixed rollers. In the centre of the weigh span so formed there is a third "weighing" roller linked to a lever scale above. The poise on this scale arm is positioned so the entire system is in balance when the weight on the centre roller is exactly one-half the weight of the coal between the weigh-span rollers. Length of the weigh span is equivalent to belt advance for one turn of the head shaft. Since the unit is designed to discharge 100-lb. per turn the system is in balance when the weighing roller carries exactly 50-lb. If instantaneous weight of coal on the weigh span is more or less than the set figure a scale arm moves slightly to close "overweight" or "underweight" contacts. These actuate a motor-driven levelling bar that regulates the volume of coal on the belt. Poise on the scale arm is positioned by a calibration motor and screw. A selector switch allows this motor to be controlled by the "overweight" and "underweight" contacts. A simple calibration procedure involves only hanging a 50-lb. test weight on the weighing roller and operating for a short time without coal on the belt.

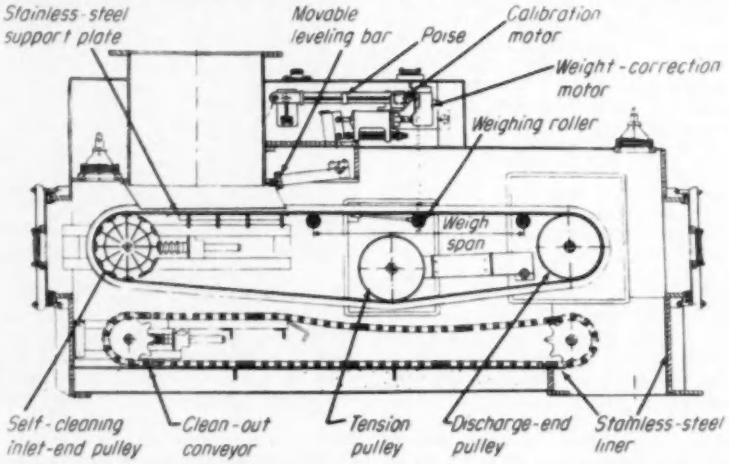


Fig. 4. Outline arrangement of weighing roller and ancillaries for continuous coal feed by weight.

The calibration motor is actuated by the weighing contacts to move the poise to an exact point of balance. This method automatically takes into consideration tare weight of the belt. For pulverised-fuel units the feeder body is a cylindrical housing. For cyclone units a dust-tight rectangular housing is designed for an internal operating pressure of 2-lb./sq. in. A belt volumetric feeder has also been developed. (*Power*, Vol. 103, No. 9, p. 140.)

Mr. R. A. Bent (managing director) and **Mr. R. J. F. Howard** (director) of **Lancashire Dynamo Electronic Products Ltd.** are making an overseas tour which commenced on September 26th. They will spend a week in Australia discussing matters relating to the manufacture of their company's products in that country and will then travel to Los Angeles for discussions in the United States in relation to possible licensing for the manufacture of their products. Opportunity will also be made to visit the company's Canadian associates before returning to this country on November 7th.

A new leaflet entitled "Midac Wet Dust Arresters," available from **The Midland Heating & Ventilation Co. Ltd.,** Bedford Road, Birmingham, 11, describes these units, which are manufactured with capacities from 250-60,000 cu. ft./min. The turbulent self-induced wet spray created in the scrubbing chamber of the Midac, combined with the precipitation occurring on the wetted impingement baffles, ensures maximum cleaning of the air. Pumps and filtering medium are not required, and as the water is in constant recirculation consumption is limited to a small make-up requirement.

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Steam generator

The furnace (4) of the steam generator shown in Fig. 1 comprises a first combustion chamber (4A), constructed in the form of a cyclone chamber having an ash-discharge opening (38) in the bottom, and a co-axial gas outlet (40) at the upper end of the chamber. The pulverised-fuel suspended in a mixture of oxygen and re-circulated combustion gas, substantially free of nitrogen and primarily composed of CO_2 gas, is conveyed into the combustion-chamber by way of burners (42). These burners are located at the four corners of the combustion chamber (4A) and, as shown in Fig. 2, are arranged to project the fuel streams into the chamber in directions tangential to an imaginary firing circle (43). According to the invention, the amount of oxygen supplied for combustion through burners (42) is proportioned so as to cause incomplete combustion of the mixture and to result in producing gaseous products of combustion, a large proportion of which consists of CO gas. Additional fuel is introduced at a lower level by way of fuel nozzles (44) also in directions tangential to an imaginary firing circle. This fuel is suspended in streams of cooled re-circulated combustion gases which are substantially free of nitrogen and composed mostly of CO_2. A lowering of the temperature and a reduction of CO_2 to CO takes place in the lower portion of chamber (4A) in an atmosphere charged with incandenscent fuel particles which are violently agitated by the whirl effect imparted to the gases, which is caused by discharging the fuel streams in tangential directions. In order to create greater turbulence it may be desirable to direct the fuel streams issuing through burners (44) in a rotational direction, which is opposite to that of burners (42). The CO gases thus generated in the lower part of the chamber (4A) are separated from the ashes by cyclonic action and pass upwards through axial gas offtake (46). The ash runs down the walls of chamber (4A), passes out through ash opening (38) and is disposed of in the usual manner. The temperature of the gases having passed through outlet (40) is reduced by giving off heat to the high temperature reheater (30) which is located directly above. It is desirable that the temperature of the CO gas be thus lowered to a point somewhat above the ignition point of CO which lies in the neighbourhood of 1,250 deg. F. Directly above the reheater section (30) is a second combustion chamber (4B). A mixture of oxygen and recirculated combustion gases, substantially free

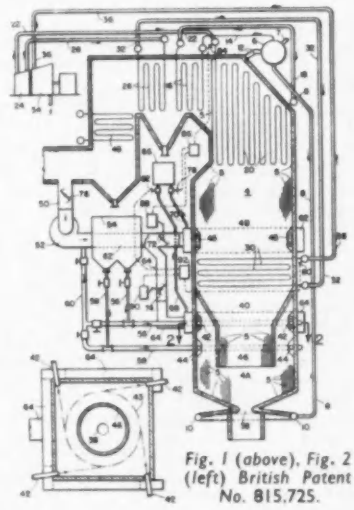


Fig. 1 (above), Fig. 2 (left) British Patent No. 815,725.

of nitrogen, is discharged into combustion chamber (4B) by way of nozzles (45) and into the body of cooled CO gases causing these gases to burn to CO_2. The heat which is thus liberated is carried by these gases into the high-temperature superheater section (20), a large portion of heat being absorbed by this section and by the low-temperature superheater section (16), and by the low-temperature reheat section (26), through which the gases pass. A recirculating duct (50), with branches (62 and 64), and fan (52) are provided to recirculate portions of the cooled combustion gases to burners (42 and 44), and oxygen nozzles (45). Since the use of atmospheric air as a carrier of oxygen for combustion is avoided as far as possible, the combustion gases are substantially free of nitrogen. A large portion of the stack loss is thereby eliminated. The fuel burned in furnace (4) may be pulverised-coal fed from a coal hopper (54) by way of fuel pipes (56 and 58) into chamber (4A). In transporting the coal, recirculated nitrogen-free combustion gas is used as a carrier gas. This gas is supplied by way of pipe (60) from a point on the pressure side of the recirculating fan (52). This fan also supplies recirculated, nitrogen-free, combustion gases to burners (42) and nozzles (45) by way of conduits (64 and 62) respectively. Oxygen stored under pressure in tank (66) is conducted to burners (42) by way of conduit (68), and to nozzles (45) by way of conduit (70). Valves are provided as required in the oxygen supply lines (68 and 70), in the fuel supply lines (56 and 58), and in the recirculated gas line (60). Dampers (72, 74 and 76) are provided in the gas ducts (62, 64 and 50) respectively to control the flow of recirculated gas to the various points of the furnace. *British Patent No. 815,725 issued to Combustion Engineering Inc. Complete specification published July 1st, 1959.*

Control equipment for steam turbines

This invention relates to improvements in control equipment for steam turbines. Control equipment for a steam turbine according to the invention includes a trip mechanism, a pilot valve controlled by the trip mechanism, and a main valve arranged to close following closure of the pilot valve; the steam supply past the pilot valve when open being taken to a selected steam nozzle or nozzles of the turbine separate from the turbine nozzle or nozzles served by the main valve. The system is illustrated schematically in Fig. 3 from which it will be seen that the turbine control equipment includes an emergency trip mechanism (*A*) so devised that centrifugal force causes a latch (*a*) to be disengaged when a predetermined turbine speed is reached. The mechanism (*A*) may incorporate some means of manual operation. The steam stop valve (*B*) is held open by a latch against the action of a

spring. This latch is interconnected by means of a link and levers with the latch (*a*) incorporated in the trip mechanism (*A*). When an excess speed is reached, these latches disengage and allow the valve (*B*) to close under the action of its spring, assisted by flow of steam. A valve, such as (*B*) may be used to shut off steam supply to a turbine. If, however, the turbine is large, or if the steam pressure is high, the valve, and in particular the valve spring,

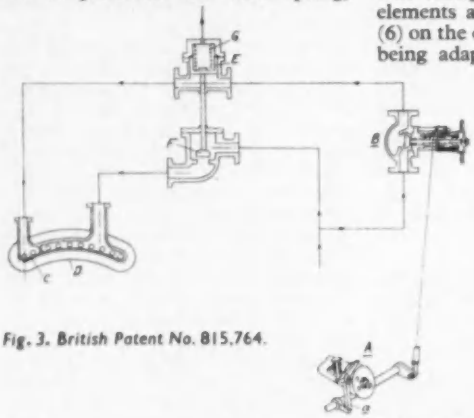


Fig. 3. British Patent No. 815,764.

have to deal with heavy forces. In the arrangement according to the invention, the valve (*B*) is used only as a pilot valve to shut off steam to one group (*C*) of nozzles in a nozzle segment (*D*). When the valve (*B*) is open, steam pressure on the underside of a piston (*E*) is high, and is sufficient to hold a main valve (*F*) open against the action of a spring (*G*). When the valve (*B*) closes, the pressure under the piston (*E*) falls, and the valve (*F*) closes under the action of the spring (*G*), thus shutting off the steam supply to the remaining nozzles in the nozzle segment (*D*). If so desired, the piston (*E*) may be arranged to seat on part of its cylinder so as to prevent leakage past the piston when the valve (*F*) is in the fully-open position. The control equipment of the invention is essentially a relay mechanism in which the main valve (*F*) is controlled by the pilot valve (*B*), the steam supply to the nozzles (*C*) being usefully employed in the turbine, while at the same time acting as an operating fluid in conjunction with the relay mechanism. *British Patent No.* 815,764 *issued to G. & J. Weir Limited. Complete specification published July 1st,* 1959.

Heat-exchanger

The heat-exchanger shown in Figs. 4 and 5 comprises a tube (1) of rectangular cross-section, furnished with a number of cross tubes (2) in staggered relation. The ends (3) of each of the tubes are enlarged so that when the tubular elements (1) are secured together they are spaced apart from one another, except at their ends, and the ends are provided with apertures (4) which are adapted to receive bolts (5), these bolts retaining adjacent tubular elements (1) together so as to form a cellular structure as shown in Fig. 5. The enlarged ends (3) of the tubular elements are provided with a groove (6) on the outer side walls, this groove being adapted to receive a packing, for example, asbestos fibre. Heating fluid flows either through the length of the tubes (1) or through the cross tubes (2) and the spaces formed between the tubular elements, and the fluid to be heated is arranged to flow either through the cross tubes (2) or through the tubes (1). The opposite sides of each tube (1) or certain of the tubes may be gilled, or may be furnished with semi-cylindrical grooves (7), as shown, so as to increase their effective external surface area. The cross tubes (2) may also be furnished with gills internally and/or externally if desired. Tubular heat-exchanger elements according to this invention may be embodied in a combustion-air heater for a steam generator; the elements being assembled between the air inlet header and the outlet header

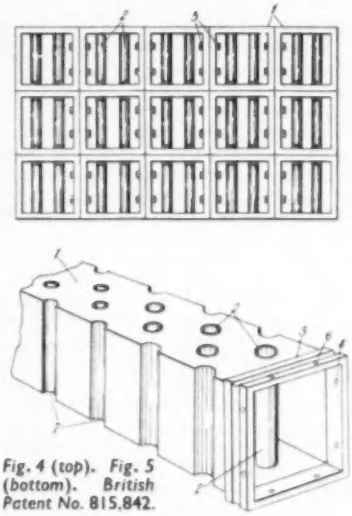


Fig. 4 (top). Fig. 5 (bottom). British Patent No. 815,842.

connected to the combustion chamber. *British Patent No.* 815,842 *issued to Senior Economisers Limited. Complete specification published July 1st,* 1959

Mr. Michael Boby, managing director, William Boby & Co. Ltd., the well-known water treatment engineers, Rickmansworth, Herts., left England on September 24th on a world sales-research trip of some 28,000 miles by air. Mr. Boby visited West Coast American research establishments to discuss patent rights and research facilities for electrodialysis—a process of purification of liquids by an electric-cell process, and one which has received world-wide recognition. Mr. Boby was also able to discuss British technical know-how on this, and allied water-treatment problems, with engineers and others in Australasia where industrial water supplies are an important problem in many areas. He called at Sydney, Melbourne, and Adelaide, and then returned to London via the west coast of America, New York and Bermuda.

* * *

John Thompson (Pipework) Company, Wolverhampton, have received a contract valued £490,000 from the C.E.G.B. for the supply of the high-pressure pipework and valves for Nos. 5 and 6 turbine sets at Blyth "B" power station, Northumberland. Each set is of 275-MW capacity, steam conditions at the turbine stop-valves being 2,300 lb./sq. in. at 1,050 deg. F., so that the main steam pipework will be designed for a pressure of 2,500 lb./sq. in. at a temperature of 1,055 deg. F. Design pressure for the feed piping will be 3,900 lb./sq. in. The contract calls for the provision of main steam lines (9-in. bore), reheater inlet and outlet lines (20-in.) and 10-in. bore main feed lines for each of the two sets, together with blowdown and high-pressure drain pipework and valves. Chrome-molyvanadium tubing, to be used for the main steam and the reheater outlet lines, will involve the application of special welding techniques. **John Thompson-Kennicott Company** are to supply the water-treatment make-up plant for the high-pressure boilers at Blyth. For these units, 500,000 gal./day of water will be required. The consulting engineers are Messrs. Merz and McLellan, Newcastle upon Tyne.

* * *

Birlec Limited has established a Midland Area sales office with **Mr. H. J. Podmore** as manager. The new office is at the company's main premises in Tyburn Road, Birmingham, 24. Mr. Podmore joined Birlec in April, 1955, as sales manager, Dryer & Gas Plant Division.

* * *

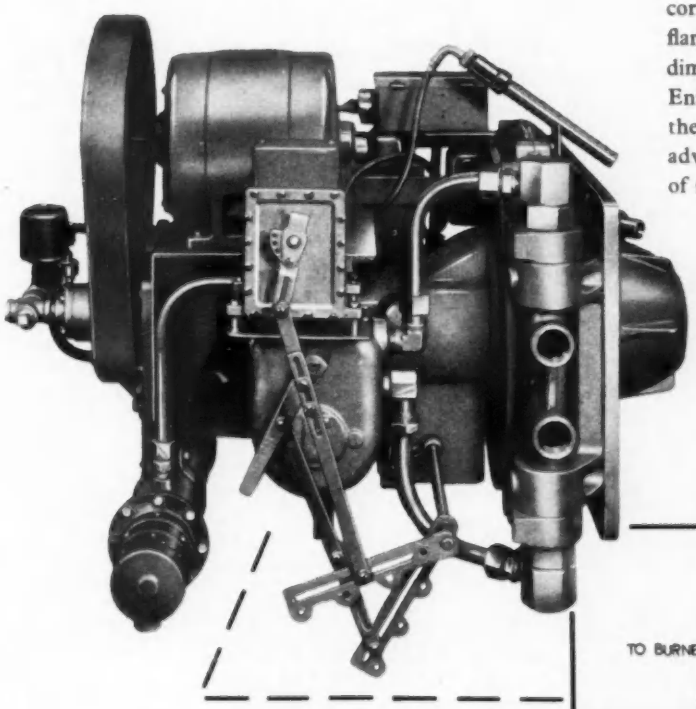
W. H. Allen Sons & Co. Ltd. have received an order from the Warwickshire Division of the West Midlands Gas Board for the supply of two 175-kW c.m.r. back-pressure single-stage steam turbines for direct-coupling to Electric Construction Company alternators for installation in the retort houses at Foleshill gas works, Coventry.

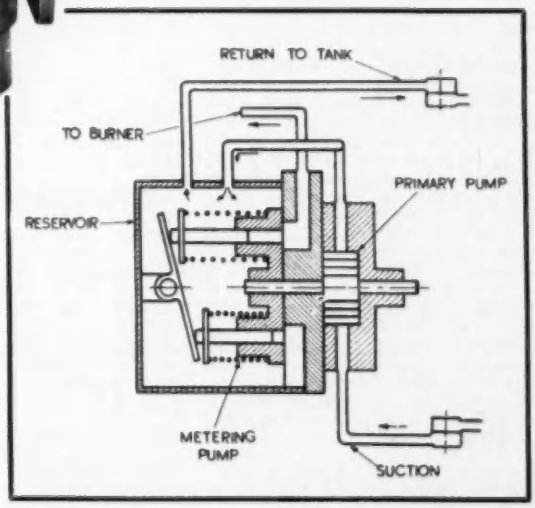
ANNOUNCING THE

SWINNEY ENTERPRISE

Automatic Rotary Oil Burner

Swinney-Enterprise Rotary Oil Burners are now available in a range of 12 sizes having outputs from 3.5 gallons per hour to 166 gallons per hour and are suitable for use with the heaviest grades of fuel. Burners are available for operation on natural, induced or forced draught and with a wide variety of control systems. By correct choice of combustion head, flame shape can be altered to suit the dimensions of the combustion chamber. Entirely manufactured in the U.K. the Swinney-Enterprise is the most advanced oil burner for firing all types of steam and hot water boilers.





The Measured Rate Metering Pump is exclusive to Swinney-Enterprise burners. Regardless of grade, viscosity or temperature of fuel the metering pump will provide the correct flow of fuel to ensure precise air/oil ratio and efficient combustion.

FOR FURTHER INFORMATION WRITE OR PHONE:—

SWINNEY BROTHERS LTD

MORPETH, NORTHUMBERLAND. Tel: MORPETH 92/3

LONDON: 34 CRUTCHED FRIARS E.C.3. Tel: ROYAL 2977

NOTES Personal AND Industrial

The President of the Board of Trade has appointed **Dr. F. Llewellyn Smith,** M.Sc., M.I.Mech.E., and **Mr. I. W. Macdonald,** M.A., C.A., to be part-time members of the National Research Development Corporation. The National Research Development Corporation was set up in 1949, under powers conferred on the Board of Trade by the Development of Inventions Act, 1948, to develop and exploit for commercial use, inventions resulting from public research, and other inventions which are not being taken up by industry, but which the Corporation considers should be assisted in the public interest.

* * *

Mr. Norman Readman, managing director, The Consolidated Pneumatic Tool Co. Ltd., has been appointed chairman of The Jacobs Manufacturing Co. Ltd., Frank Guylee and Sons Ltd., and the Reichdrill Manufacturing Co. Ltd.

* * *

The development branch of the Mond Nickel Company's development and research department has recently been reorganised into four divisions under the general managership of **Mr. F. Dickinson,** a director of the company. The divisions and the respective managers are as follows:—Ferrous Division, **Mr. W. W. Braidwood,** Non-Ferrous Division, **Mr. J. Hinde,** Applicational Engineering Division, **Dr. A. B. Everest,** General Division (including plating, chemical products and nuclear power), **Dr. E. C. Rhodes. Mr. L. W. Johnson,** at present assistant manager of the department, having reached retirement age, relinquished his appointment at the end of September.

* * *

Mr. David Williams, B.A. (Hons.), warden and tutor at the Residential Training Establishment of the Electricity Council at Horsley Towers, Surrey, has been appointed deputy education and training officer to the Electricity Council. Mr. Williams, who has been at the training establishment for four years, was previously organising tutor in adult education for South-West Lancashire, and tutor in economic history and industrial relations to extra-mural courses organised by the University of Manchester.

* * *

Mr. G. J. Lyons has been appointed secretary of The Institution of Plant Engineers in succession to **Mr. R. F. Farmer,** who has resigned to take up an appointment with The Institution of Civil Engineers. The appointment of Mr. Lyons became effective on September 21st.

* * *

Mr. R. S. Medlock, A.M.I.Mech.E., A.M.I.E.E., technical and home sales director of George Kent Limited, has been elected president of the Society of Instrument Technology.

Mr. I. McKerrow, B.Sc.(Eng.), M.I.E.E., A.M.I.Mech.E., contract electrical engineer with Babcock & Wilcox Limited, since 1946, has now been appointed senior electrical engineer in the company's Atomic Energy Department. As contract electrical engineer, he was responsible for all electrical work associated with conventional boiler plant projects and contracts. In his new post he will be in charge of all electrical work in the Atomic Energy Department on nuclear plant projects and contracts. He will also be available for consultation on electrical engineering matters to all the company's departments at home and abroad. Before joining Babcock & Wilcox, Mr. McKerrow held various appointments at the Trafford Park Works of the Metropolitan-Vickers Electrical Co. Ltd.

* * *

Mr. Peter J. Field, formerly chief assistant public relations officer of the Central Electricity Generating Board, has been appointed public relations officer of the Board in succession to **Mr. L. J. Luffingham** who, on reaching retiring age, leaves the Board's service. Mr. Field became assistant press officer of the then newly-established British Electricity Authority in 1948. He was subsequently appointed press officer and, with the reorganisation of the electricity supply industry, became chief assistant P.R.O. of the Generating Board.

* * *

The British Pitometer Co. Ltd. announces the appointment of the following additional directors: **Mr. Alexander Robertson, Dr. P. L. Boucher** and **Mr. W. J. Robinson,** M.I.Mech.E.

* * *

Crofts (Engineers) Limited, Bradford, Yorks., have appointed two additional representatives for the London area, viz.: **Mr. L. C. Blake** and **Mr. A. E. Peggs.** Both will operate from 34, Norfolk Street, Strand, W.C.2, telephone No. Temple Bar 8731-2-3, to which any queries on power transmission should be addressed.

* * *

Mr. L. C. Southcott, B.Sc., A.M.I.Mech.E., hitherto assistant managing director, The Superheater Co. Ltd., has been appointed joint managing director.

* * *

Mr. V. M. Fox, A.M.I.E.E., until recently in charge of the company's Swansea Office, has been appointed manager of Industrial Machines Department, Rugby, of the A.E.I. Motor and Control Gear Division.

* * *

Mr. J. M. Kay, M.A.(Cantab.), Ph.D., M.I.Mech.E., Professor of Nuclear Power, Department of Mechanical Engineering, Imperial College of Science and Technology, has accepted an invitation to be president of the Junior Institution of Engineers for 1959-60.

Mr. Charles Soukup, managing director, Richard Klinger Limited, has retired owing to ill-health. Mr. Soukup had been associated with the company for nearly 50 years, and on reaching his 65th birthday in October, 1956, was presented with his portrait in oils by the management and staff. His retirement coincides with the birth of a new venture in Australia where he has planned an efficient and enterprising unit, now nearing completion, for the manufacture of Klingerit high-pressure jointing. Had ill health not intervened, Mr. Soukup would have been in Australia for the inauguration of the plant.

* * *

A.E.I. Electronic Apparatus Division announce the appointment of **Mr. D. N. Relf,** M.B.E., A.M.I.E.E., as manager, Industrial Electronic Apparatus Sales Department.

* * *

The Central Electricity Generating Board has announced the appointment of **Mr. J. H. Butler** to the post of generation engineer to the North-Eastern Division.

* * *

Mr. A. I. Groushko, B.Sc., A.M.I.Mech.E., M.Inst.F., has been appointed southern area manager for Archibald Johnstone (Engineers) Limited, Garforth, near Leeds, and 60, Abbey House, Victoria Street, London, S.W.1.

* * *

Foxboro-Yoxall Litmited manufacturers of industrial control instruments, have this year reached their 25th anniversary. A number of special events have been planned to mark this occasion and two of these, an open day and a sports day, were held on September 4th and 5th.

* * *

The administrative and technical departments of **Film Cooling Towers (1925) Limited** have moved to new and more commodious premises, in view of the increasing demand for water-cooling towers designed on their special Film Flow principles. The new address is: Chancery House, Parkshot, Richmond, Surrey. Richmond 6494 8.

* * *

Murex Welding Processes Limited, Waltham Cross, Herts., have purchased the whole of the issued shares of **Donald Ross & Partners Limited,** Crawley, Sussex, specialists in the design and manufacture of mechanical aids to production and in particular the well-known "Twinner" positioners for hand and automatic welding. While Donald Ross & Partners Limited will continue to operate as in the past and under the same name and the same management, this association will enable both companies to offer individually and jointly a first-class specialist service to users of welding, and to companies contemplating installation of mechanical aids to production.

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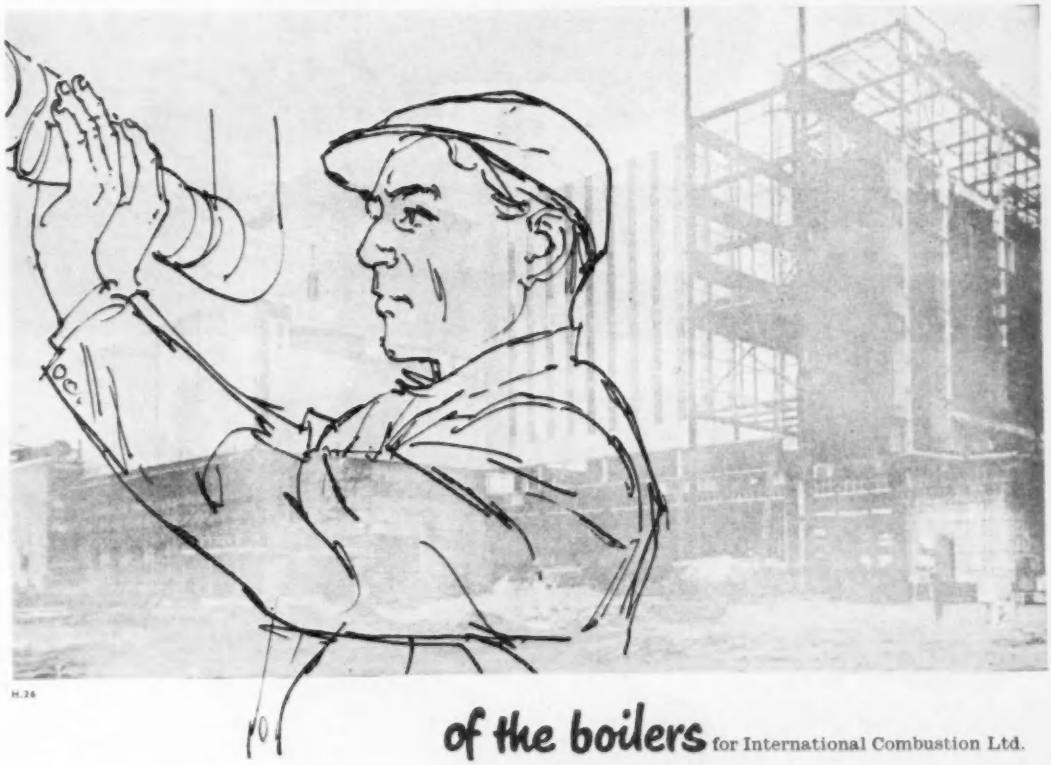

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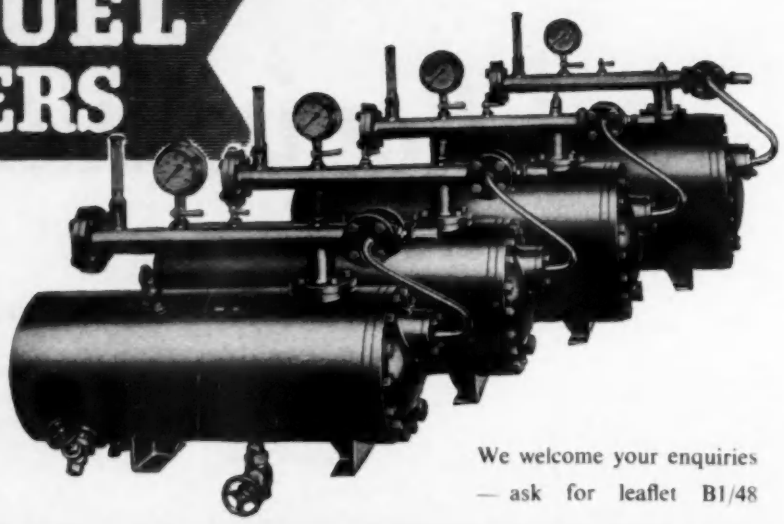

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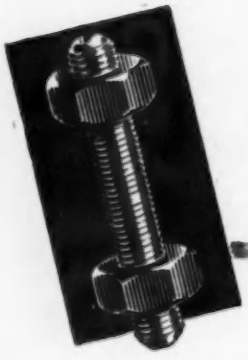

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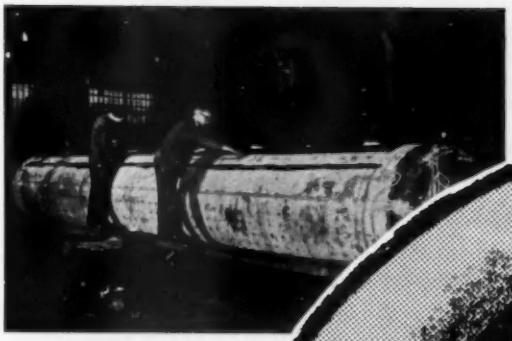

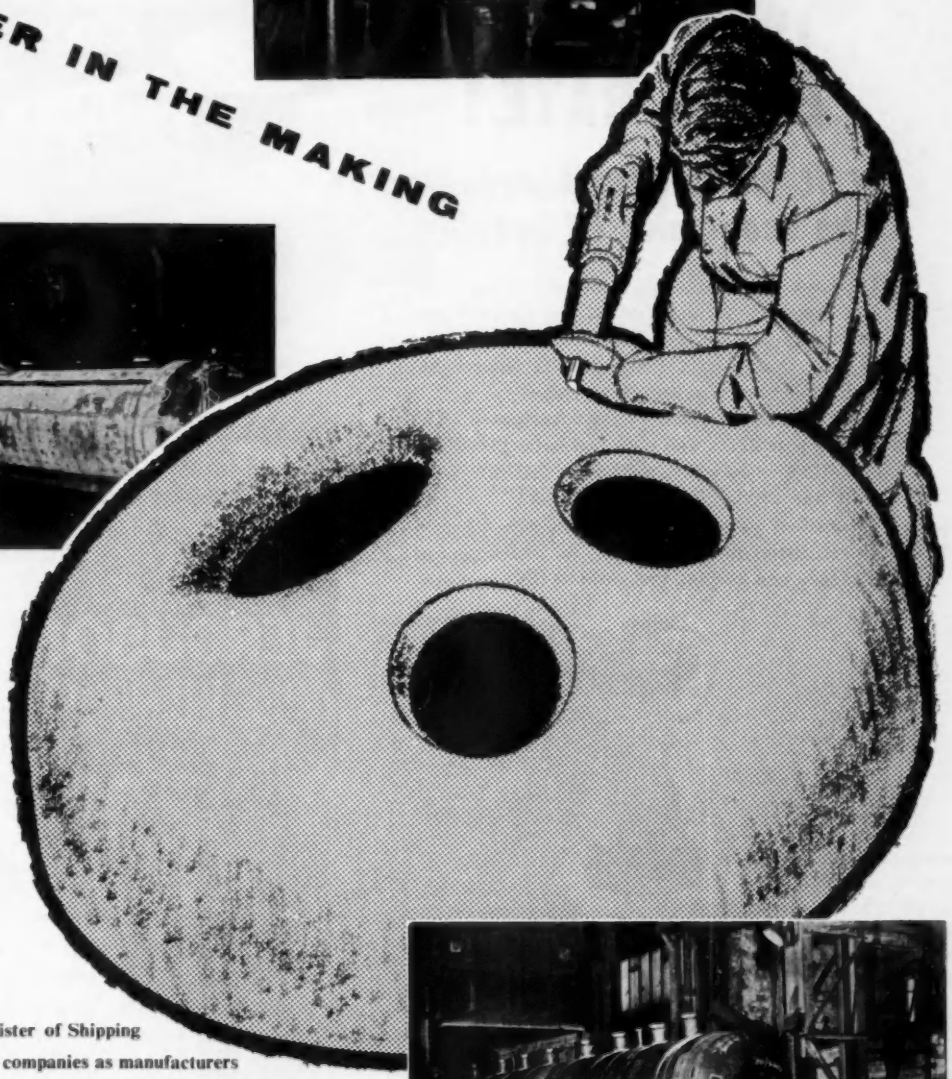

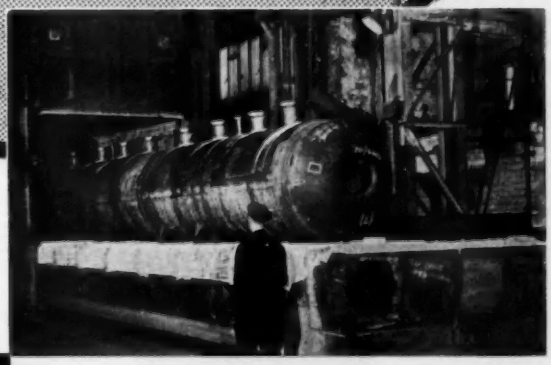

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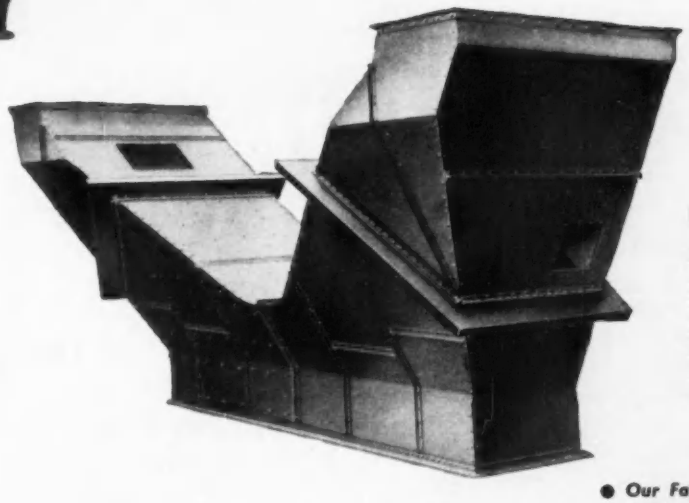

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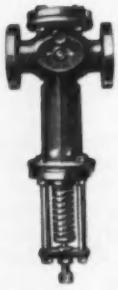

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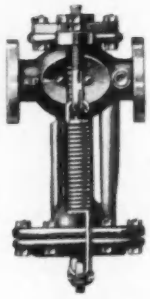

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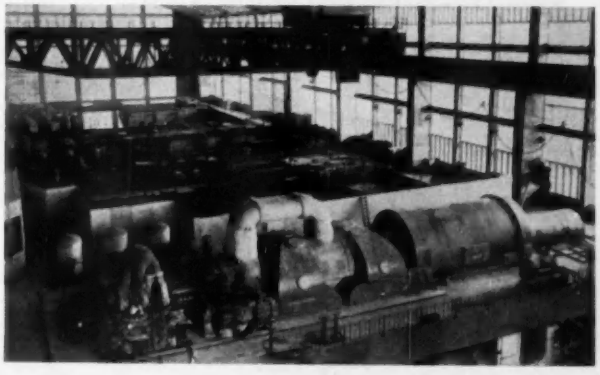

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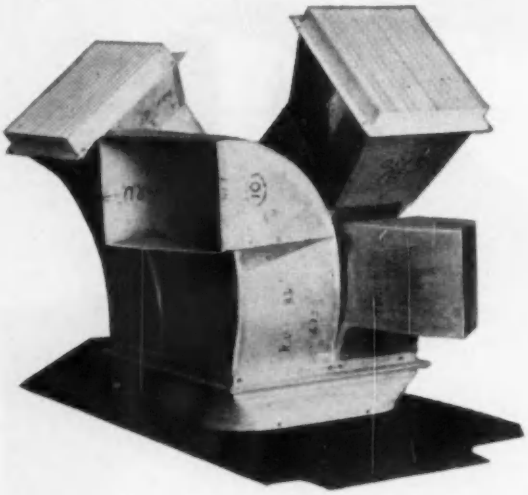

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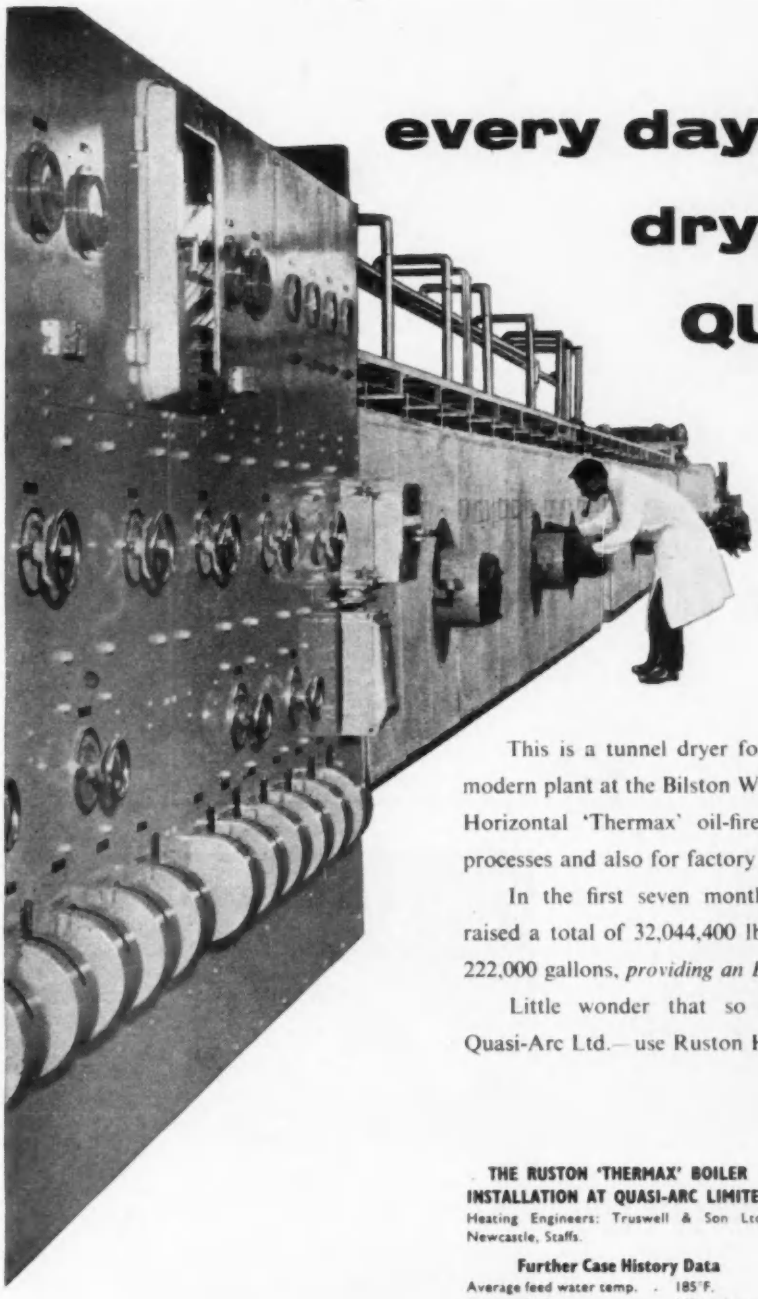

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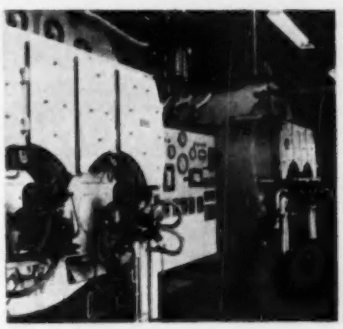
Average CO_2 reading	13%
Average exit flue gas temp.	420°F.



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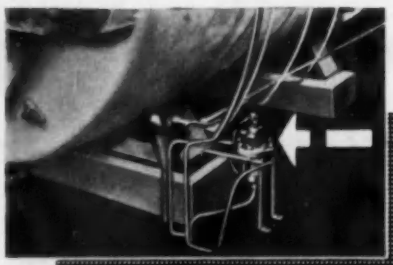

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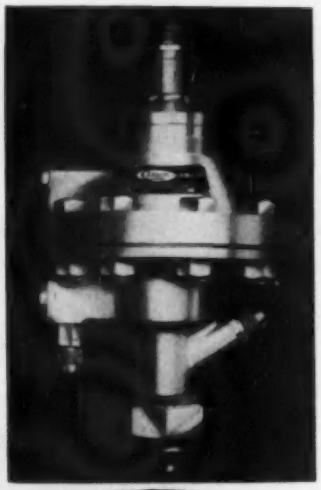

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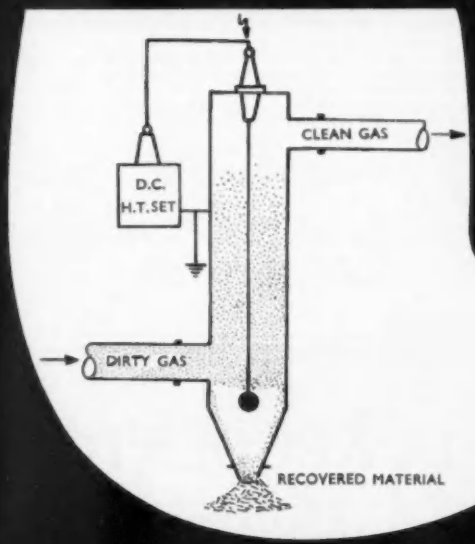

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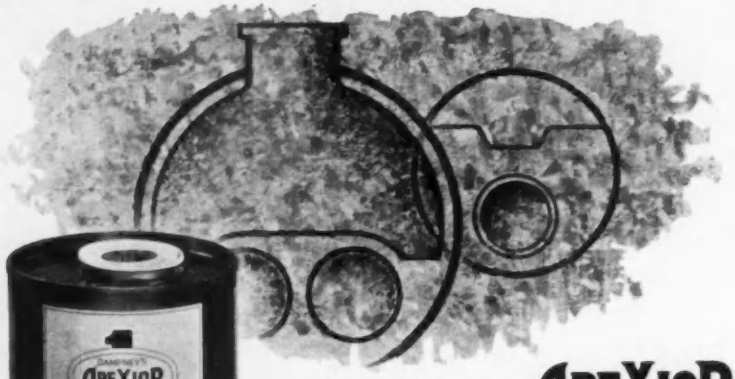

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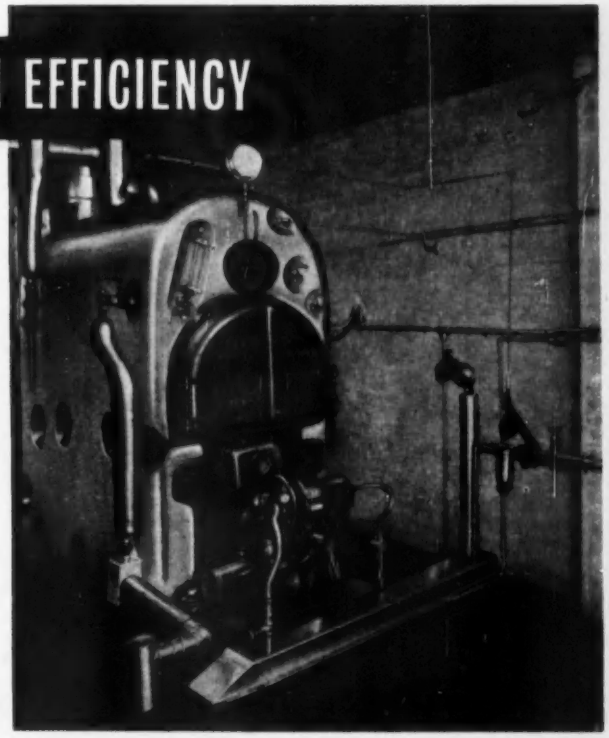

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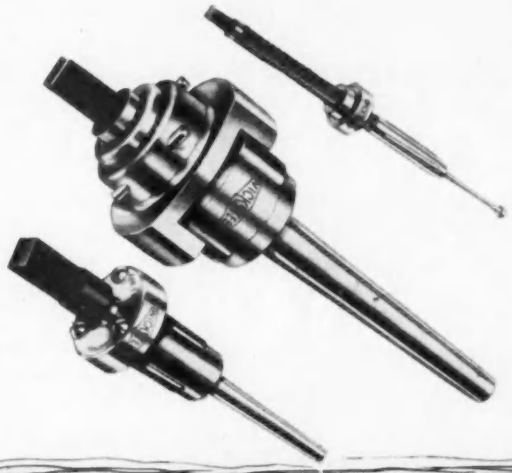

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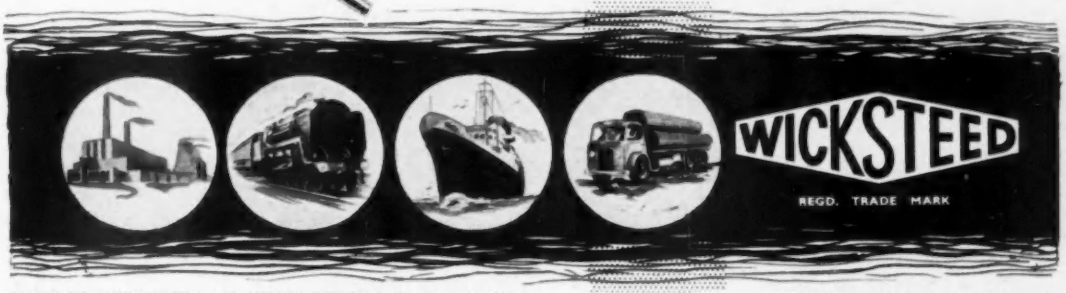

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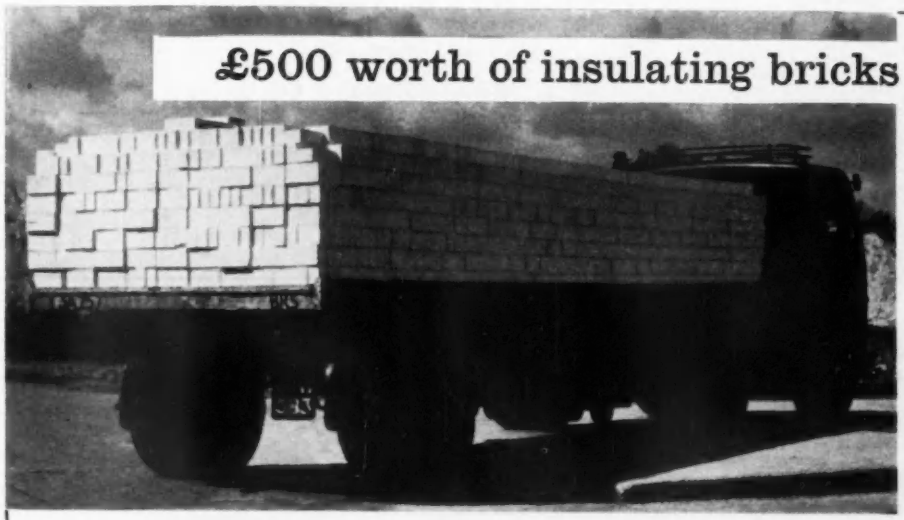

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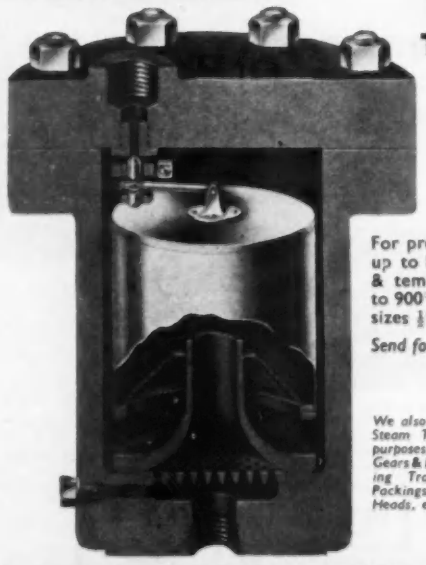

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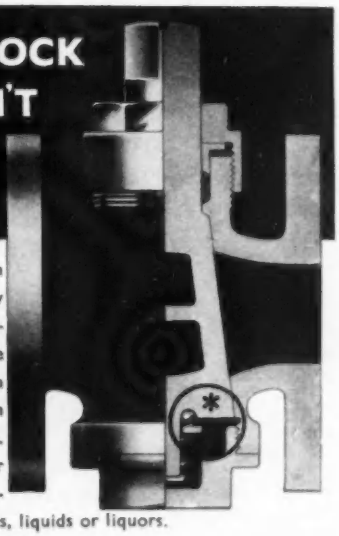

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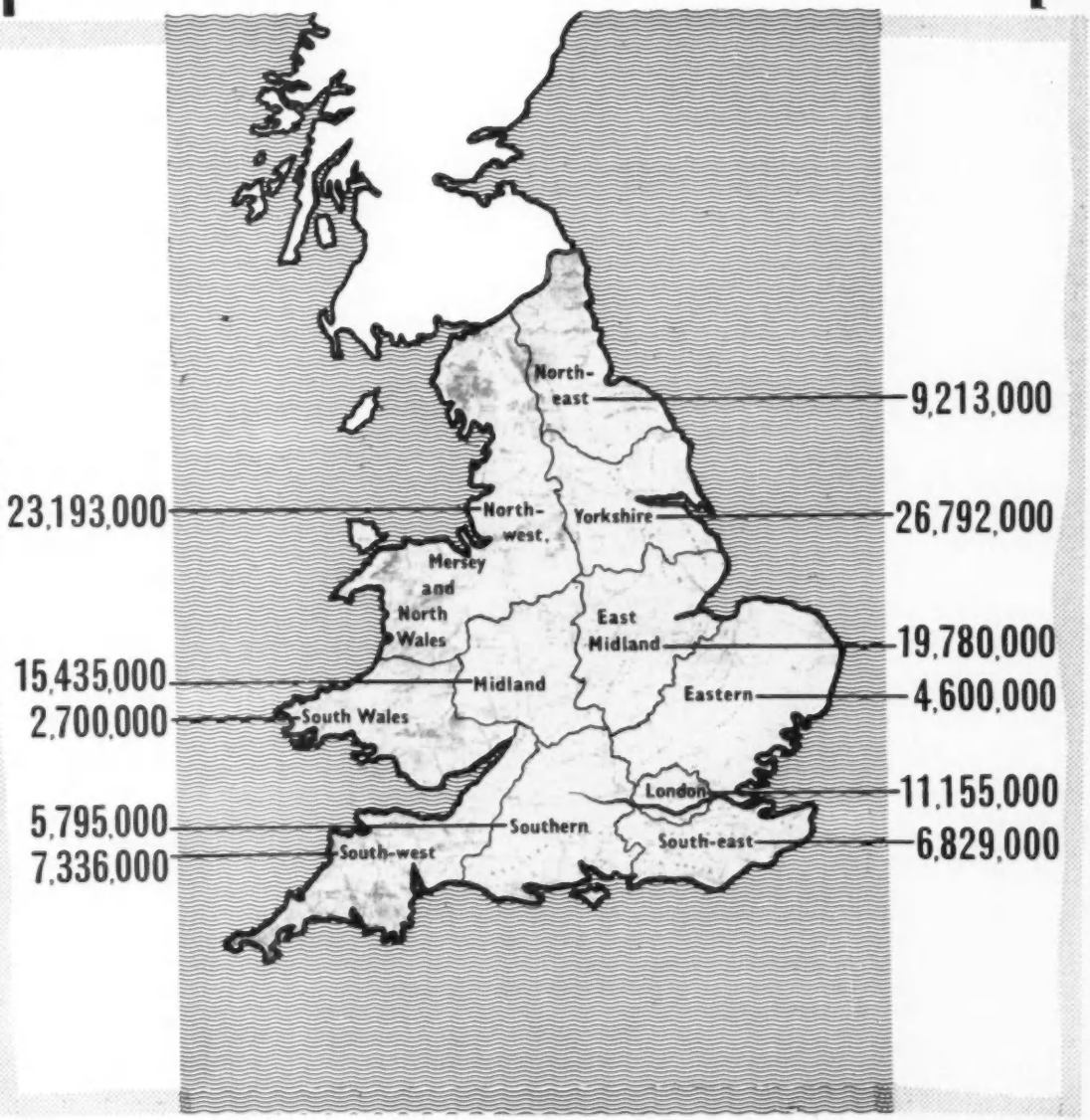

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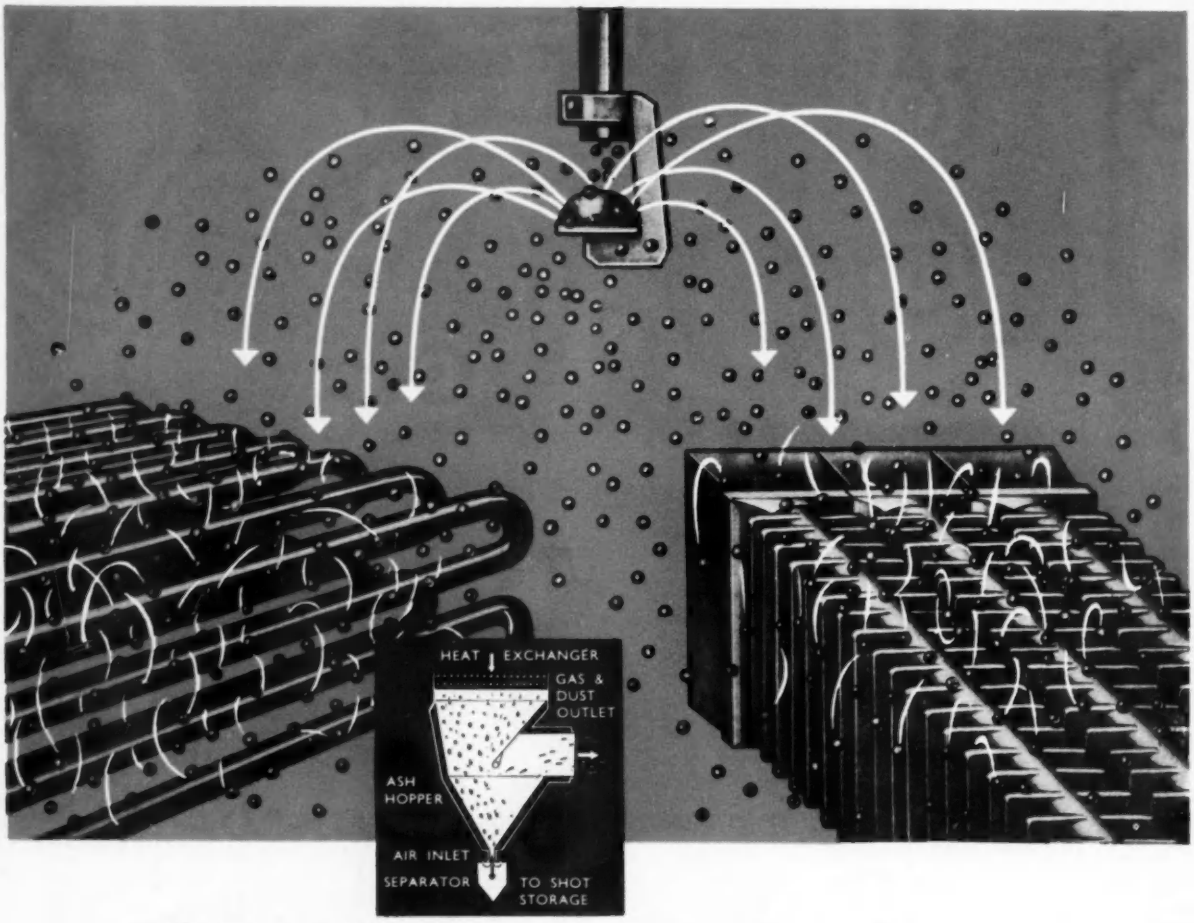

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